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PB-245 082

ECONOMIC IMPACT ANALYSIS OF EFFLUENT GUIDELINES:
ANIMAL FEED, BREAKFAST CEREAL AND WHEAT STARCH
SEGMENTS OF THE GRAIN MILLS INDUSTRY

DEVELOPMENT PLANNING AND RESEARCH ASSOCIATION,
INCORPORATED

PREPARED FOR
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AUGUST 1975

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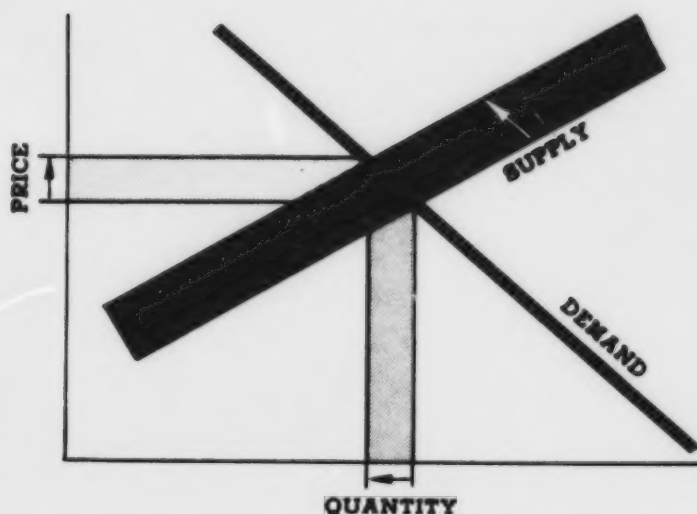
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EPA 230/1-7⁵-038
August, 1975

PB 245 082

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Office of Planning and Evaluation
Washington, D.C. 20460



BIBLIOGRAPHIC DATA SHEET		1. Report No. EPA 230/2-75-038	2.	3. Recipient's Accession No.
4. Title and Subtitle Economic Impact Analysis of Effluent Guidelines: Animal Feed, Breakfast Cereal and Wheat Starch Segments of the Grain Mills Industry		5. Report Date August, 1975		6.
7. Author(s) Samuel G. Unger, Robert J. Buzenberg, Alan H. Ringleb		8. Performing Organization Rept. No.		9. Performing Organization Name and Address Development Planning and Research Associates, Inc. P. O. Box 747, 200 Research Drive Manhattan, Kansas 66502
10. Project/Task/Work Unit No. Task Order No. 13		11. Contract/Grant No. Contract No. 68-01-1533		12. Sponsoring Organization Name and Address Environmental Protection Agency Waterside Mall 4th and M Streets, S.W. Washington, D. C. 20460
13. Type of Report & Period Covered Final Report		14.		15. Supplementary Notes

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16. Abstracts. The economic impacts of proposed effluent limitations guidelines on three segments of the grain milling industry were assessed: animal feed (SIC 2042) breakfast cereal (2043) and wheat starch-gluten (2046) processing. The analysis included classification and description of types of firms and plants, evaluation of pricing mechanisms and relationships and financial profiles of selected model plants. Financial impacts of proposed effluent treatment technology were assessed in terms of price, industry returns, and production volume. Employment, community impact and international trade effects were also assessed. Limits of the analysis were stated.

Overall, the proposed controls of this study (point source category only) will neither directly nor seriously impact the three segments studied in the short run. Water effluent problems of the animal feed segment are inconsequential and detailed assessments were not required. Virtually all breakfast cereal and wheat starch

17. Key Words and Document Analysis. 17a. Descriptors

Water pollution, economic analysis, economics, animal feed, breakfast cereal, wheat starch, vital wheat gluten, food, pollution, industrial wastes, demand, supply, prices, variable costs, fixed costs, fixed investment, discounted cash flow.

17b. Identifiers/Open-Ended Terms

02 Agriculture, B - Agriculture economics
05 Behavioral and Social Sciences, C - economics

17c. CONATI Field/Group

18. Availability Statement

PRICES SUBJECT TO CHANGE

19. Security Class. This Report UNCLASSIFIED	21. Total Pages 110
20. Security Class. This Page UNCLASSIFIED	22. Price \$25-2.25

16. Abstracts (continued)

processing plants are connected to municipal treatment systems and this minimizes applicability of the proposed guidelines. The breakfast cereal industry is sufficiently viable to withstand proposed costs for pollution control facilities if required. However, the potential impacts of the guidelines on the wheat starch segment are such that new entrants into the industry would not be expected if private treatment systems were required. The industry growth prospects for the wheat starch processing segment are thus uncertain.

FINAL REPORT

ECONOMIC IMPACT ANALYSIS OF EFFLUENT GUIDELINES:
ANIMAL FEED, BREAKFAST CEREAL AND WHEAT STARCH
SEGMENTS OF THE GRAIN MILLS INDUSTRY

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Prepared for
Office of Planning and Evaluation
Environmental Protection Agency
Washington, D. C. 20460
Contract No. 68-01-1533
Task Order No. 13
August, 1975

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PREFACE

The attached document is a contractor's study prepared with the supervision and review of the Office of Planning and Evaluation of the U.S. Environmental Protection Agency (EPA). Its purpose of effluent limitations guidelines and standards of performance established by EPA pursuant to sections 304(b) and 306 of the Federal Water Pollution Control Act.

The study supplements an EPA technical "Development Document" issued in conjunction with the promulgation of guidelines and standards for point sources within this industry category. The Development Document surveys existing and potential waste treatment and control methods and technologies within this category and presents the investment and operating costs associated with various control technologies. This study supplements that analysis by estimating the broader economic effects (including product price increases, continued viability of affected plants, employment, industry growth and foreign trade) of the required application of certain of these control technologies.

This study has been submitted in fulfillment of Contract No. 68-01-1533 Task No. 13 by Development Planning and Research Associates, Inc. Work was completed as of August, 1975. The study is based primarily upon an earlier study, also prepared by Development Planning and Research Associates entitled "Economic Analysis of Proposed Effluent Guidelines for Animal Feed, Breakfast Cereal and Wheat Starch Segments of the Grain Mills Point Source Category". The earlier report was circulated in conjunction with the publication of the Federal Register of a notice of proposed rulemaking under sections 304(b) and 306 for the subject point source category. The analysis contained in the original study has been revised based upon information received during the period of time between publication of the notice of proposed rulemaking and the promulgation of the final regulation. Because of the constraints of time, the control and treatment costs analyzed in this study may not in all instances be identical to those associated with the requirements of the promulgated regulation. However, these differences, when they exist, are minor insofar as the final conclusions of the study are concerned.

This report represents the conclusions of the contractor. It has been reviewed by the Office of Planning and Evaluation and approved for publication. Approval does not signify that the contents necessarily reflect the views of the Environmental Protection Agency. The study has been considered, together with the Development Document, information received in the form of public comments on the proposed regulation, and other materials in the establishment of final effluent limitations guidelines and standards of performance.

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ECONOMIC IMPACT ANALYSIS OF EFFLUENT GUIDELINES:
ANIMAL FEED, BREAKFAST CEREAL AND WHEAT STARCH
SEGMENTS OF THE GRAIN MILLS INDUSTRY

EXECUTIVE SUMMARY

The economic impacts of proposed point source effluent guidelines on three grain mill products industry segments were assessed in this study: (1) Cereal Breakfast Food, (2) Wheat Starch Processing, and (3) Animal Feeds. The following brief summary highlights the purposes, procedures, and findings which are developed in detail in the final report.

BACKGROUND

The primary purpose of this study was to analyze the potential economic impacts of pollution abatement requirements on each of the three above named industrial segments. Specific focus was placed on the analysis of probable price effects, financial effects, production effects, employment effects and community effects which are expected following implementation of point source effluent control guidelines.

This study was completed pursuant to the Federal Water Pollution Control Act Amendment of 1972. The implementation of this Act, as amended, requires that regulations for the control of effluents from industrial point sources be developed and that effluent guidelines be established to meet federal clean water standards. The guidelines for the industry segments of this study have been proposed in a separate development document. ^{1/} Prior to the imposition of such guidelines, however, an evaluation was necessary of various economic impacts on the industry segments and the national economy.

The study and final report were prepared under the supervision and review of the Office of Planning and Evaluation of the U. S. Environmental Protection Agency (EPA) by Development Planning and Research Associates, Inc. (DPRA).

SUMMARY AND CONCLUSIONS

In each of the segments, it is emphasized that most existing plants are currently discharging their wastes into municipal treatment systems. The guidelines proposed herein do not apply to such plants directly. Hence, even in the case of wheat starch processing, the economic impacts are quite limited on an industry-wide basis when considering only the point source category guidelines of this study.

^{1/} Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Animal Feed, Breakfast Cereal and Wheat Starch Segment of the Grain Mills Point Source Category, Sverdrup & Parcel and Associates, Inc., April, 1974.

For the three industry segments studied, potential impacts of the proposed effluent regulations ranged widely from virtually "no impact" for the animal feeds segment to the probable closure of those wheat starch segment "model" plants which direct discharge and which do not increase prices substantially. (About a 5 percent increase in composite wheat starch-gluten prices was projected to reduce the likelihood of plant closures in the wheat starch segment.)

A related and growing concern to these segments is the potentiality of prospective changes in municipal treatment standards and increased costs to industrial users. In some plants presently utilizing municipal systems, management is evaluating pretreatment systems and/or private treatment systems which might lower their overall treatment costs. Future outlooks for all industry plants are conditioned by prospective industry-wide treatment requirements and costs as well as the proposed point source category requirements. The price and production effects reported in this study were difficult to quantify exactly, for the affect of pollution control costs upon affected plants is also influenced by the competitive role of plants which are not affected by pollution controls. Thus, affected plants cannot wholly and directly pass through their costs so long as non-affected plants play a determinant role in setting product prices. In general, it is unlikely that plants with direct discharges will recover full costs of pollution controls, and for some plants (especially in wheat starch processing) plant closures and/or barriers-to-entry for new plants with prevalent technology would be expected.

SYNOPSIS OF REPORT

The analysis of economic impacts and other findings of the study are briefly outlined below in the same order as contained in the final report.

I. Industry Segments

The three grain mill products industry segments analyzed were as follows:

SIC 2043 - Cereal Breakfast Food. This segment is comprised of three basic cereal preparations: ready-to-eat (RTE), hot cooked, and natural breakfast foods. Only the RTE subsegment required detailed analysis because the others have no process waste waters that require treatment.

SIC 2046 - Wheat Starch Processing. Water effluents are a major problem for this portion of the SIC 2046 industry (corn wet milling). Improved technology in the industry will reduce effluent problems, but existing plants are affected by the proposed controls. Estimated treatment costs are relatively high for both existing plants and for new sources employing current technology.

SIC 2048 - Animal Feeds. The economic impacts of proposed water effluent controls on this industry segment are negligible. Process waste waters are insignificant. The industry uses water primarily for steam generation and cooling, non-product contact processes, and such water is not subject to the proposed guidelines; consequently, the industry realizes no impact from the EPA guidelines. No further analysis was required in the final report.

For the reasons given, this report analyzed only two segments--cereal breakfast food and wheat starch processing--in detail.

A. Cereal Breakfast Food Segment

In 1974, the cereal breakfast food industry was composed of 26 firms operating 47 plants. Of this total, 17 plants were RTE plants and three were combination RTE and hot cooked cereal plants. All 20 employed process waste waters.

RTE plant sizes range widely from under 200,000 to over 1,000,000 pounds per day. (Representative model plants of 200,000 lbs/day, 500,000 lbs/day and 1,200,000 lbs/day were analyzed in detail in the study in order to assess differential impacts by plant size.)

The firms in the cereal industry are widely diversified, principally into other food processing activities. Leading firms in cereal manufacture, e.g., Kelloggs, General Foods (Post), General Mills, Quaker Oats, are among the nation's largest companies, and their operations are international in scope. Although somewhat concentrated in the North Central Region, plants within the U.S. are located in sixteen states with some concentration in the North Central region.

The cereal breakfast food industry has been a growth industry. Employment in 1972 was estimated at 12,800, up from 12,200 in 1967. The value of shipments are over \$1 billion per year, making it a leading economic segment within the grain mill products industry. The greatest recent growth in production and sales has been with RTE and the natural cereal breakfast foods.

Only the RTE subsegment of the cereal breakfast food industry has process water effluents requiring treatment.

B. Wheat Starch Processing Segment

Important to this industry is that only two main products are manufactured: wheat starch and vital wheat gluten. The latter high-protein product (constituting only 14 percent of the raw material flour input) is a highly valued ingredient in the baking industry and, more recently, in the texturized vegetable protein products industry. With about half of its value of sales in gluten products, the industry might more accurately be called the wheat starch-gluten industry.

The grain mill products industry segment is relatively small with only seven plants currently operated by six firms. Two new plants are under construction. These new plants were constructed primarily to manufacture vital wheat gluten which is in short supply and incorporate major technological changes. No plants are reported for additional construction of plants with prevalent technology.

Wheat starch plants are typically affiliated with much larger grain mill products firms, especially flour milling companies, e.g., General Mills, Centennial Mills, Pillsbury. These plants, utilizing "second clears" and low grade flours from flour mills as raw material input for further processing, are usually located in wheat producing areas and adjacent to flour mills. Existing plants are relatively old, and until recently, the numbers of plants have steadily declined. New plants generally differ so from older ones that strict comparisons are not applicable.

Existing plant sizes range narrowly from about 750 to 1,500 hundredweight (cwt) of flour processed per day. A single representative model plant with 1,000 cwt/day capacity is used in the detailed analysis to depict this industry segment. Employment in the industry is estimated at about 150 (excluding new plants) and value of shipments are currently about \$17 million per year. While this segment is small in comparison to other industry segments, the products produced are important intermediate products for other food processing and manufacturing industries.

Although all but one plant presently utilizes municipal discharge systems, the wheat starch processing requires such large amounts of water for processing that the segment is concerned about future, more stringent pollution controls.

II. Financial Profiles

Industry financial profile data reflect industry profitability, capital structure, the cost and availability of capital, pro forma income statements, invested capital and the cost structure of model plants by segment. Much of the information requested by EPA was not generally available for these industry segments; consequently, considerable emphasis and reliance on model plant estimates by DPRA were necessary and were critical to the impact analysis which follows in section VI, below.

A. Cereal Breakfast Food Segment

Recently the cereal breakfast food industry has generally been very profitable. Reported net profits of major cereal companies have ranged from about 8 to 21 as a percent of net worth, with about a 15 percent average. Net returns on sales have ranged from less than 2 percent to over 8 percent, averaging near 4 percent. These data represent total corporate earnings which only partially reflect cereal plant operations. RTE cereal plants are relatively more profitable than is shown in consolidated earnings reports.

A major underlying financial characteristic of the RTE subsegment is its capital structure. The subsegment is capital intensive. RTE plants are normally much larger than either hot cooked or natural breakfast food plants and DPRA's three model plants reflect plant investments (including working capital) from \$15 million to \$75 million. Most of the major cereal companies have been established for many years, and their reported fixed debt to net worth ratios are generally low. (This condition strengthens the capital availability position of the industry if additional capital from external sources is required.)

Based on the model plant pro forma income statements which were developed for this study, the RTE model plants have estimated relatively high returns on sales of about 11 to 13 percent. A critical assumption in the model plant analysis is reflected in the budgeted expenditures for marketing and sales costs. The estimated indirect costs for these functions represented about 18 percent of sales, a measure that reflects the expenditures for advertising and promotion which are a trademark of both the cereal industry and the packaged food industry. An individual plant or company could vary considerably from this budgeted level for marketing and sales in relative terms. (A further aspect of this industry is its emphasis toward maintaining market shares, an emphasis which makes market entry difficult for new firms.)

Semi-detailed cost structures for the model plants are shown in the report. The industry's emphasis on marketing and sales programs its capital intensiveness and its extensive warehousing-distribution systems result in actual raw materials costs (for oats, corn, wheat, rice, etc.) that are relatively low in relation to sales, i.e., about 20 to 22 percent. This ratio is less than that of most other food processing industries.

Due to the financial strength of the cereal breakfast food industry, the companies in the industry are not expected to have major difficulty in acquiring additional capital for pollution controls. The firms also have a strong cash flow position due both to turnover in sales and to depreciation allowances which are sizeable in capital intensive industries.

B. Wheat Starch Processing Segment

The financial characteristics of wheat starch processing plants are exceptionally difficult to ascertain from consolidated financial statements of their parent grain milling firms. In many cases, average industry statistics for grain milling firms were used for segment's data, however, engineering cost synthesis methods were used to develop a "typical" model plant of 1,000 cwt/day. Much of the financial data presented were derived from the simulated operations of the model plant.

Historically, grain mill products firms have had net profit to sales ratios of about 3 percent and net worth to sales ratios of about 10 percent, generally less than the averages for all manufacturing industries. The model plant financial data were comparable to these industry data, i.e., net income to sales ratio of 3.9 percent. This estimate was based on a pro forma income statement and financial return analysis of the selected model plant.

Capital investment requirements (including working capital) for the wheat starch model plant were estimated at slightly over \$1 million on a replacement cost basis for a prevalent technology plant. Most plants using old technology have been in operation for some time and the financial returns shown were based on estimated book values. In this case, the return on invested capital was about 13 percent for the plant. A comparable financial analysis was not possible to new plants utilizing new technology since their operating data are unavailable. Their capital investment requirements are higher than those of other plants.

On an annualized cost basis, the cost structure of the model wheat starch plant is dominated by the cost of raw materials (i.e., low grade flour) which represented about 80 percent of total sales, a high ratio for the grain mill products industry. Marketing and sales costs are minimal because sales are direct to industrial buyers (both starch and gluten products are intermediate products which are further processed by other manufacturing industries). Firms have minimal product differentiation and do not publically advertise.

The ability to finance new investment in the wheat starch processing industry is limited to the financial strength of the wheat starch plant; however, the affiliation of these plants with larger, diversified firms would enhance their position for acquiring moderate levels of additional capital if continued operations were economically feasible.

III. Pricing

The price determination processes (demand/supply conditions) for both the cereal breakfast food and the wheat starch processing industries are described in this section. Each segment is quite distinct in its marketing and price determination mechanisms.

A. Cereal Breakfast Food Segment

Packaged cereal breakfast foods are prepared primarily for retail consumer markets; consequently, these goods are prepared and packed for such markets at the processing plant, regardless of whether intermediate wholesalers, jobbers or other distributors become involved in the marketing-distribution chain. Any marketing-promotion programs geared to a particular product line are also normally coordinated from the processor level.

In the three basic types of cereal plants as identified, the industry produces many breakfast cereal products within each subsegment. In many instances product forms are similar, but differentiable, and they are marketed in varying package sizes. In the last 20 years over 150 cereal brands have been produced.

Ready-to-eat cereals, generally produced from one or more of the basic grains--corn, oats, wheat and rice--may be flaked, puffed, extruded, or shredded. They may be coated with sprays of sugar, vitamins, minerals, etc. to fortify and/or sweeten the product. Many new products, especially breakfast cereals with relatively higher protein content, have recently been introduced.

In general terms, no more than 4 percent of the total crop of oats, wheat, corn, rice or barley is used for cereal production; hence, the industry is neither constrained by nor does it dominantly influence these basic commodities markets.

A characteristic of the cereal breakfast food industry has been its aggressive advertising and sales promotion programs. To promote consumer preference for individual product brands, cereal makers on the average are reported to spend about 13 percent of their cereal sales revenue for advertising. In a related matter, Federal Trade Commission action is currently pending against the four leading cereal companies, charging these firms with having a shared monopoly with over 90 percent of the ready-to-eat cereal markets in the U. S. The FTC claims that industry practices have resulted in artificially inflated prices, excessive profits, limitations on product innovation, and a general lessening of competition. The outcome of these FTC charges could affect the future structure of the industry.

DPRA's data indicated that marketing and sales costs are generally high for all firms studied. The industry emphasizes market share goals entailing varied forms of non-price competition. Though a new firm might readily establish a production capability, its market penetration would undoubtedly be difficult in this long established market where company and brand loyalties do exist. The usual market behavior in such an industry seeks to maintain company and brand loyalties with non-price forms of competition.

The proposed point source effluent controls are not expected to directly alter product prices. Affected plants should not be dislocated due to the proposed guidelines.

B. Wheat Starch Processing Segment

In extreme contrast to the cereal industry, wheat starch processing involves the manufacture of essentially undifferentiated products (both starch and gluten). The products are sold principally to industrial buyers by private treaty arrangements without public advertising or promotion.

Such a market structure results in minimal indirect expenses for marketing, sales, and related administrative overhead costs. As the model plant financial profiles indicated, an exceptionally high proportion of the total costs of operation are for raw materials, e.g., about 80 percent of the total

sales revenue; thus major influences on prices are the cost of commodities (i.e., wheat) and associated flour milling costs.

Starch and gluten sales show considerably different marketing characteristics markets. Wheat starch sales (mainly to the paper industry) compete directly with other industrial starches (predominantly corn starch), and wheat starch processors can do little to make independent cost/price adjustments. Wheat starch suppliers are basically "price takers".

Vital wheat gluten (primarily used in baking and texturized vegetable protein manufacture) shows almost opposite marketing characteristics. It has no close substitutes, gluten products are in short supply in growing world markets (the U.S. imports about 40 percent of its current needs), and world competition for available supplies has been increasing.

Thus, the wheat starch industry would be best able to recover pollution control costs through its gluten product subsegment. Gluten prices are susceptible to increases and new plants are designed to improve both the production and yield of vital wheat gluten products.

Although price increases are not expected directly due to the proposed point source guidelines because of their limited applicability for existing plants, the industry, as a whole, anticipates higher waste treatment costs regardless of current plant waste arrangements. This expectation results in projected price increases which would apply to new sources and/or plants which might discontinue municipal treatment services. A composite price (revenue) increase of about five percent was projected.

IV. Economic Impact Analysis Methodology

As implied in the foregoing discussion, the primary methodology for assessing expected economic impacts for each of the segments studied was to develop and analyze the financial and operating characteristics of hypothetical but representative model plants.

The core analysis for this study was based upon an engineering-economic synthesis of both the physical and financial characteristics of representative (model) plants in each of the industry segments. Where necessary, various types of sensitivity analyses were performed to reflect potentially relevant differences among existing plants, e.g., size, age, technology and other physical or economic conditions. Such procedures are regularly used in pre-investment feasibility analyses by industry, and though no single operation is precisely simulated, the analysis indicates the approximate and relative effects of add-on pollution control treatment practices. Both pre- and post-treatment analyses were performed to determine incremental as well as aggregate economic impacts.

Estimated industry-wide impacts were based on an extrapolation of model plant effects for all affected plants in the industry segment. Economic information external to an individual plant was also required in order to project industry-wide effects. Both commonly accepted microeconomic and macroeconomic factors and procedures were utilized to interpret and extend representative model plant results.

The main analyses performed were designed to examine a series of specific effects such as price, financial, production, employment, community and balance of trade. (The underlying procedures used are explained in the final report and a schematic of the overall methodological steps utilized in the impact analysis for each segment is shown in Figure IV-1 of the final report.)

One of the main impact assessments of this study involved a determination of probable plant closures. Generally, older plants will not make capital investment costs that cannot be recovered through increased returns that would be greater than those realized by alternative capital investments. DPRA used a net present value analysis to estimate expected long-term net returns and to compare them to potential returns from plant salvage and alternative investment activities (an alternative cost principle). To compare these alternatives, all expected future returns were discounted at the cost of capital rate to present values. A net present value of less than zero in the current business would imply that plant closure would be expected. These and other procedures are covered in detail in the final report.

V. Pollution Control Requirements and Costs

The water pollution control standards, technology, and costs used in this analysis were furnished by the Effluent Guidelines Division of EPA from materials developed in part for the Agency by Sverdrup and Parcel and Associates (S&P). The basic data constructed by S&P were adapted to the types and sizes of plants designated in this analysis.

Three effluent guidelines were considered:

- BPT - Best Practicable Control Technology Currently Available, to be achieved by July 1, 1977
- BAT - Best Available Pollution Control Technology Economically Achievable, to be achieved by July 1, 1983
- NSPS - New Source Performance Standards, apply to any source for which construction starts after the publication of the proposed regulations for the Standards

Brief descriptions of the recommended technology (and estimated costs) for achieving the three guidelines in each segment were presented in non-technical terms in this report. However, to avoid duplication and possible confusion, no technical descriptions of BPT, BAT and NSPS guidelines were given. (The interested reader is referred to EPA's technical report for technology descriptions. 1/)

Summaries of each industry's current waste treatment practices and experiences with waste treatment controls were presented. It is known that at least some firms in the wheat starch segment are having difficulty in meeting the proposed guidelines via transfer of technology from other industries. In other words, the proposed technology has not yet been proven within this industry segment.

VI. Impact Analysis

The imposition of point source effluent guidelines on the ready-to-eat cereal and the wheat starch processing industries is not expected to result in significant direct impacts on either industry principally because nearly all existing plants are on municipal treatment systems with which their pollutants are compatible enough to render pretreatment unnecessary. To illustrate potential impacts, however, model plant analyses were completed. Furthermore, new plants would be affected if they should directly discharge into surface waters.

New source performance standards (NSPS) are comparable to the proposed BAT guidelines, and the costs for BAT control were supplied to hypothetical new source model plants in both industry segments. In the wheat starch industry the proposed guidelines would result in a probable barrier to entry for plants which would employ prevalent technology. In the cereal breakfast food industry, the proposed guidelines would not likely prohibit entry based on comparable types of financial analysis.

A. Cereal Breakfast Food Segment

For all three sizes of RTE cereal model plants, the proposed guidelines would lower profitability and investment returns. Prices in the industry are not expected to increase, however. Although the affected plants would incur increased costs representing about a .4 percent price increase for the medium sized model plant, the predominance of plants linked to municipal treatment systems would competitively prevent a compensating price increase.

While profitability and returns on investment would be lowered, increased control costs will not force plant closures nor prohibit the entry of a new plant. The estimated treatment costs are extensive, e.g., about \$875,000

1/ Development Document, Ibid.

for a medium sized RTE plant, but this level is not prohibitive in relation to basic capital requirements of the RTE segment, e.g., about \$34 million for the same model plant.

Because plant closures are not expected and because prices are not expected to increase due to point source guidelines, all other studied effects were projected as negligible. Production would not be reduced, and there should be no major employment dislocations or community impacts. In general, the RTE cereal segment should meet the proposed guidelines without significant economic dislocations either to individual plants or to the industry.

B. Wheat Starch Processing Segment

In this industry, only one plant currently discharges directly into surface waters and that does so only after starch wastes have been utilized in a distillery operation. (A treatment plant is under construction to treat the distillery wastes.) One plant is expected to discontinue discharge into a municipal system following completion of an on-site land disposal system. All other plants are on municipal systems.

Because of the limited applicability of the proposed control guidelines, then, the industry-wide direct effects are expected to be minimal. On the other hand, the proposed regulations would result in severe impacts on any affected plant, including new sources. An impact analysis was completed on the model plant case, therefore, to illustrate the potential impacts which could result.

Based on model plant analysis, two main potential impacts were as follows: (1) An existing medium sized plant would require about a 9 percent composite price increase (or 9 percent increase in sales revenue) in order to recover the proposed incremental costs for pollution control, and (2) a new source plant with prevalent technology would likely be prohibited from entry because of both the higher replacement cost for plant facilities and the relatively high pollution control costs as shown in this study.

A further assessment was made of the potential price pass-throughs which may be expected within the wheat starch-gluten industry. Demand and supply prospects for starch and gluten products, especially vital wheat gluten, are such that a 5 percent composite price (sales) increase was projected due to likely pollution control impacts on the industry as a whole (involving mostly plants on municipal systems).

Existing plants might then recover sufficient costs to remain operative if private treatment systems were needed, but new sources using existing technology would still not likely enter the industry.

The foregoing impact assessments were largely hypothetical based on model plant analysis. The purpose was to illustrate potential impacts on either new plants or on existing plants which might leave municipal treatment systems.

In conclusion, because of the predominance of municipal hook-ups, overall industry impacts of point source category guidelines should be minimal. Production, employment and balance of trade factors should not be affected, and community effects should be inconsequential. As indicated, prices of wheat starch and gluten products are likely to be increased by about 5 percent to offset higher municipal treatment system costs. Perhaps the main direct impact is that new source plants which use prevalent technology and which directly discharge would be prohibited from entry due to the extensive cost burden of private treatment systems as proposed.

An important further consideration in this study, however, was that improved technological processes to produce vital wheat gluten have been introduced. Such technology is expected to replace existing plant technology and to reduce water emissions and control problems. Such facilities will likely replace existing plants over time. In fact, two new plants with the new processes are under consideration.

VII. Limits of the Analysis

The impact analysis presented was based upon data and information from industry sources, from published secondary data sources, and from estimates prepared by DPRA. Subjective judgments were also required. The analysis is limited in part, by the accuracy of the data utilized and by analytical procedures which required simplifying assumptions subject to variability within a given industry.

In this final section of the report, DPRA presented its own assessment of the reliability and the general accuracy of the data utilized, the possible ranges of errors in key data, and the critical assumptions. In addition, selected sensitivity analyses were performed to assess the relative importance of key parameters, e.g., price levels, cost of capital, etc.

In particular, the most critical assumptions of this study involved the representativeness of the model plants, the model plant cost data, the prices and inflation, and the cost of capital. These limits were described in Chapter VII.

Another limit to the analysis involves the degree of applicability of the proposed guidelines within each industry segment. A concluding subsection of the report discusses the current state of waste water treatment in the industries studied.

ECONOMIC IMPACT ANALYSIS OF EFFLUENT GUIDELINES
ANIMAL FEED, BREAKFAST CEREAL AND WHEAT STARCH
SEGMENT OF THE GRAIN MILLS INDUSTRY

I. INDUSTRY SEGMENTS

The economic impacts of proposed point source effluent guidelines have been assessed in this study for three grain mill products industry segments: (1) Cereal Breakfast Food - SIC 2043; (2) Wheat Starch Processing - SIC 2046; and (3) Animal Feeds - SIC 2048. ^{1/} The economic impacts expected vary widely both among and within these three segments. The following synopsis outlines the basic impacts and explains the general contents of this report:

SIC 2043 - Cereal Breakfast Food. This segment includes three basic types of cereal preparations: ready-to-eat (RTE), hot cooked, and natural breakfast foods. Only the RTE subsegment has process waste waters that require treatment; this study, then focuses on the RTE subsegment of the industry.

SIC 2046 - Wheat Starch Processing. ^{2/} This industry segment represents only one part of the SIC 2046 (Wet Corn Milling) industry as defined by Census of Manufactures. It is a relatively minor industrial segment of SIC 2046 as well as of the overall grain mill products industry. Water effluents are a major problem for the industry, and direct discharge treatment requirements are a serious threat to the industry as it currently exists.

SIC 2048 - Animal Feeds. ^{3/} The impacts of water effluent controls on this industry segment are negligible because process waste waters are virtually non-existent. Water used primarily for steam generation and cooling, has no product contact and, thus, is not subject to the guidelines proposed herein. Consequently, this industry segment is not studied in detail in this report.

^{1/} SIC represents the Standard Industrial Classification code as used by the Census of Manufactures.

^{2/} Only wheat starch processing operations are discussed in this report. In a prior EPA study, the impacts on the corn wet milling segment of SIC 2046 were assessed (Economic Analysis of Proposed Effluent Guidelines for Selected Grain Mill Products Industries, EPA-230/T-73-014, August 1973).

^{3/} A description of the industry and the reasons for excluding the industry from further analysis are explained in the report: Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Animal Feed, Breakfast Cereal and Wheat Starch Segment of the Grain Mills Point Source Category, Sverdrup & Parcel and Associates, Inc., April, 1974.

(Originally another four-digit SIC code was proposed for study: SIC 2047 (Dog, Cat and Other Pet Foods). However, significant water effluent problems were encountered in neither the "dry" or "semi-moist" pet food segments. Canned (wet) pet foods are expected to involve water effluents of consequence, but this segment was not a part of this study.)

Thus, an analysis of industry effluent characteristics determined that the present study focus on two industries: the RTE cereal industry and the wheat starch processing industry. Within each of these primary segments, key subsegments are also considered.

A. Cereal Breakfast Food Segment

The cereal breakfast food industry includes processing plants primarily engaged in manufacturing breakfast cereal and related preparations. Three types of cereal plants are commonly recognized within the industry: (1) ready-to-eat (RTE), (2) hot cooked, and (3) natural breakfast cereals.

This study focuses on the 17 RTE subsegment plants and three combination RTE and hot cooked cereal plants which have substantive process waste water emissions that require treatment. The remainder of the industry, hot cooked and natural breakfast cereal plants, has insignificant processing waste water emissions.

1. Types of Firms

Size and Number of Firms

The total cereal breakfast food industry has 26 firms which operate 47 plants (see Table I-1). The major firms are among the world's largest food processing companies, e.g., Kellogg, General Foods, General Mills, Quaker Oats, etc. and generally represent widely diversified food processing operations. The cereal breakfast foods portion of the companies' operations may not necessarily be their dominant enterprise, for these companies also process cake mixes, baby foods, pet foods, snack goods, bakery goods and frozen foods as well as a wide variety of other food and non-food items.

Cereal breakfast food plants, per se, range widely in capacity from less than 200,000 pounds per day to well over 1,000,000 pounds. The largest plants, e.g., Kellogg and Post, are commonly referred to as super size plants. Plant size data are not completely available; however, the smaller plant sizes are typically associated with the hot cooked and the natural breakfast cereal operations. These plants generally produce about 50,000

Table I-1. Breakfast cereal industry firms and plant locations, 1973

The Kellogg Co. Battle Creek, Michigan 49016 Plants: Battle Creek, Mich. Memphis, Tenn. Omaha, Neb. San Leandro, Cal.	Baker/Beech-Nut Canajoharie, N. Y. 13317 Plant: Canajoharie, N.Y.
General Foods-Post Division Battle Creek, Michigan 49016 Plant: Battle Creek, Mich.	CPC International Inc. Englewood Cliffs, N.J. 07632 Plant: Buffalo, N. Y.
General Mills Minneapolis, Minnesota 55440 Plants: Buffalo, New York S. Chicago, Ill. Toledo, Ohio Lodi, Calif. W. Chicago, Ill.	Fisher Mills Seattle, Washington 98134 Plant: Seattle, Wash.
The Quaker Oats Company Chicago, Illinois 60654 Plants: Cedar Rapids, Iowa Danville, Ill. St. Joseph, Mo. Shiremanstown, Pa.	Fruen Milling Minneapolis, Minn. 55405 Plant: Minneapolis, Minn.
Nabisco, Inc. New York, N. Y. 10022 Plants: Minneapolis, Minn. Niagara Falls, N.Y. Naperville, Ill. Oakland, Calif.	Gerber Products Company Fremont, Mich. 49412 Plants: Ft. Smith, Ark. Fremont, Mich. Oakland, Calif. Rochester, N. Y.
Ralston Purina Co. St. Louis, Mo. 63188 Plants: Battle Creek, Mich. Cincinnati, Ohio Davenport, Iowa	H. J. Heinz Pittsburg, Pa. 15230 Plant: Pittsburgh, Pa.
International Multifoods Minneapolis, Minn. 55402 Plants: Carrollton, Mich. Manhattan, Kansas	H. C. Knoke & Company Chicago, Illinois 60650 Plant: Chicago, Ill.
	Larrowe Mills Penn Yan, N. Y. 14527 Plant: Penn Yan, N. Y.
	Little Crow Milling Co. Warsaw, Indiana 46580 Plant: Warsaw, Ind.
	Malt-O-Meal Co. Northfield, Minnesota 55057 Plants: Northfield, Minn. (2) Stockton, California

Table I-1. Breakfast cereal industry firms and plant locations, 1973
(continued)

National Bakers Services, Inc.
Broadview, Illinois
Plant: Broadview, Ill.

National Oats Co.
Cedar Rapids, Iowa 52402
Plant: Cedar Rapids, Iowa

Pet, Inc.
St. Louis, Mo. 63166
Plant: _____, Michigan

Pillsbury Co.
S. Minneapolis, Minnesota 55402
Plant: S. Minneapolis, Minn.

Richard Foods Corporation
Melrose Park, Illinois 60160
Plant: Melrose Park, Ill.

Roman Meal Co.
Tacoma, Washington 98411
Plant: Fargo, N. D.

Standard Milling Co.
Kansas City, Mo. 64105
Plant: Highspire, Pa.

Uncle Sam Breakfast
Omaha, Nebraska 68111
Plant: Omaha, Neb.

Van Brode Milling Co.
Clinton, Massachusetts 01510
Plant: Clinton, Mass.

Colgate Palmolive Co.
Chicago, Illinois 60654
Plant: _____, Illinois

pounds per day. In contrast, RTE plants are larger in general and range widely in size throughout the industry. In this study, representative RTE model plant sizes are depicted as producing 200,000 lbs/day, 500,000 lbs/day and 1,200,000 lbs/day. ^{1/}

While detailed plant size data are not generally known, market shares by company have been estimated. Within the cereal breakfast foods industry, the Kellogg Company easily dominates the U.S. and world cereal markets with a market share of over 40 percent of the U.S. total. Market shares of the major firms in the industry in the early 1970's were approximately as follows:

<u>Firm</u>	<u>Estimated Market Share (%)</u>	<u>Number of Plants</u>
Kellogg	43	4
General Mills	18	5
General Foods (Post)	18	1
Quaker Oats	11	4
Ralston Purina	)	3
International Multifoods	) --- 5	2
Nabisco		4
All Others	5	24
Total	100	47

Level of Integration and Diversification

The firms in the breakfast cereal industry are generally widely diversified, principally into other food processing activities. Some companies also have interests in many non-food items such as clothing, toys, and pet foods.

Furthermore, the firms are frequently multi-national with sales and production in several countries. The top seven cereal companies are all listed in Fortunes top 500 companies. General Foods, the largest, is currently ranked 39th. Five additional cereal processors are among the top 500 companies, but their cereal division are relatively small compared to their other types of manufacture.

Within this industry, there is substantial horizontal integration. Vertical integration is less apparent. Firms competitively purchase raw materials from the agricultural sector, although some growers may produce commodities under contract with a particular processor.

^{1/} Representative plant sizes for the RTE subsegment were developed in the Development Document, Ibid.

Although direct ownership of final marketing facilities is not significant, major cereal companies tend to have sophisticated processor-wholesaler-retailer marketing relationships. The large cereal companies do typically maintain major warehousing-distribution facilities in consuming (vs. producing) areas, and this influences their economic relationships with customers.

2. Types of Plants by Segment

This section includes information relative to type, size, location, age, technology and the efficiency of plants within the cereal breakfast food industry. Breakfast food plants vary in the type of breakfast cereal processed, i.e., ready-to-eat, hot cooked, and natural breakfast foods. The known types of plants are indicated, by size category, in Table I-2. Both ready-to-eat (RTE) and hot cooked cereals are produced in several plants. (Only the RTE plants have significant water effluents; hence, the subsequent pollution control analysis is effectively applicable to only these plants.) Cereal breakfast food plants may also produce similar items such as snack foods, cake mixes, and some pet foods. This variation in processing affects overall waste treatment requirements and the impact of effluent limitation guidelines.

Since much industry information is considered proprietary data, individual plant size data are generally not available, but plant locations are as indicated in Table I-1. Also, a summary of the number of cereal breakfast food plants by state is as follows:

<u>State</u>	<u>No. of Plants</u>
Illinois	7
New York	6
Michigan	6
California	5
Minnesota	5
Pennsylvania	3
Iowa	3
Nebraska	2
Ohio	2
Tennessee	1
Missouri	1
Kansas	1
Washington	1
Arkansas	1
Indiana	1
North Dakota	1
Massachusetts	1
Total	47

Table I-2. Types of breakfast cereal plants by size category.

Type	Size Category ^{1/}			Total
	Small	Medium	Large	
Ready-to-eat (RTE)	7	8	2	17
Hot cooked	12	--	1	13
Both (RTE and hot cooked)	1	2	--	3
Natural	6	2	--	8
Unclassified	6	--	--	6
	32	12	3	47

^{1/} Size categories: Small--50,000 to 300,000 pounds/day; Medium--300,000 to 1,000,000 pounds/day; and Large (super sized)--over 1,000,000 pounds/day. Wide variability in size exists both among and with the types of plants shown. The smaller plants within the small size category are generally hot cooked or natural cereal plants. RTE plants are usually larger in thruput volume within each size category. In this study, representative RTE plants are estimated as follows: small-200,000 lbs/day, medium - 500,000 lbs/day, and large-1,200,000 lbs/day. This subsegment is of primary concern in this study.

Source: Estimated by DPRA based on discussions with industry representatives.

Existing in 16 states, cereal processing plants are widely dispersed in the U.S. Though found in all geographic regions, the greatest concentration of capacity is in the North Central area.

Plant age is not generally meaningful in this industry. Buildings may be quite old, but modern equipment and improved technologies are usually employed. Because of rather constant in-house equipment replacement and modernization, the industry is considered to be efficiently operated at the processing plant level. Expanded operations have largely been in the "natural" breakfast foods area, and quite modern facilities have generally been installed.

3. Number of Plants and Employment

Plant numbers by type were as shown in Table I-2 above. There are no precise data available concerning employment by plant in the cereal breakfast food industry. Manpower requirements have, therefore, been estimated as follows.

The cereal breakfast foods industry has been a growth industry in employment as well as in output based on the 1972 Census of Manufactures preliminary report for SIC 2043. Estimated employment was 12,800 (all employees) in 1972, up from 12,200 in 1967 (an increase of 5 percent). Production workers were estimated at 10,800 in 1972 (84 percent of all employees).

DPRA estimated employment per plant approximately as follows:

<u>Plant Size</u> ^{1/}	<u>No. of Plants</u>	<u>All Employees</u>	
		<u>Ave. per plant</u>	<u>Total</u>
Small	32	40	1,280
Medium	12	310	3,720
Large (super size)	3	2,600	7,800
	47		12,800

According to Census, 25 of the 47 plants had 20 employees or more, and conversely, 22 plants had less than 20 employees. Based on this data, the "typical" small plant would not employ the average shown. More precise data were not available, however.

^{1/} Size categories: Small--50,000 to 300,000 pounds per day; Medium--300,000 to 1,000,000 pounds per day; and Large (super-sized)--over 1,000,000 pounds per day. As noted elsewhere, the smallest plants are typically the hot cooked and natural breakfast food types of plants.

4. Relationship of Segments to Total Industry

The following summary of Census of Manufactures data for the SIC 204 grain mill products industrial group provides a basis of comparison for the industry segments in this study.

<u>SIC</u>	<u>Description</u>	<u>Number of Establishments</u>	<u>All Employees (1,000)</u>	<u>Value of Shipments (\$ mil.)</u>
2041	Flour milling	541 ^{1/}	18.0 ^{2/}	2,451 ^{2/}
2042	(See 2047 and 2048) ^{4/}			
2043	Cereal preparations	47 ^{3/}	12.8 ^{3/}	1,085 ^{3/}
2044	Rice milling	56 ^{3/}	4.0 ^{3/}	679 ^{3/}
2045	Blended flour	148 ^{1/}	6.3 ^{2/}	574 ^{2/}
2046	Wet corn milling	41 ^{3/}	12.1 ^{3/}	832 ^{3/}
2047	Pet food	204 ^{3/}	13.7 ^{3/}	1,359 ^{3/}
2048	Prepared feeds	2,087 ^{3/}	43.5 ^{3/}	4,952 ^{3/}

^{1/} 1957 Basis

^{2/} 1971 Basis

^{3/} 1972 Basis

^{4/} SIC 2042 split in 1972 into SIC 2047 and 2048 as described.

As portrayed in this summary, cereal preparations (SIC 2043) (despite the relatively small number of plants within this industry) is an important industry segment within the 204 group both in terms of employment and value of shipments.

5. Likely Impacted Segments

Within the cereal breakfast food industry, only the RTE plants have substantial water effluent emissions. The hot cooked and natural cereal plants do not generate significant water effluents. (Naturally, combination plants with RTE cereals would produce effluents of concern.)

Subsequent RTE model plant cost analysis of water pollution controls is used to establish the expected economic impacts on representative plants. In general, cereal breakfast food operations appear quite viable, and this industry segment as a whole is economically strong; thus, the industry in general may be expected to withstand moderate pollution control costs without major adverse consequences.

The smaller sized cereal breakfast food plants are the most vulnerable to adverse impacts from added pollution controls. However, the small RTE plants, e.g., 200,000 lbs/day, are substantially larger than either the hot cooked or natural breakfast cereal plants, and this difference reduces the impact effects. Even "small" RTE model plants have considerable economies of scale in production (and waste treatment costs per unit of flow) as is later shown in Chapter VI.

B. Wheat Starch Processing Segment

The wheat starch processing industry segment includes plants primarily engaged in manufacturing wheat starch and vital wheat gluten. This industry is currently experiencing technological shifts in processing and new entrants into the industry utilize improved technology to better supply vital gluten products.

1. Types of Firms

Size and Number of Firms

The wheat starch processing industry is comparatively small, having only six firms with a total of seven plants currently in operation. (Two new operations are expected to come on-stream in 1974, which will increase gluten capacity in the industry by more than 25 percent. Since these new plants have been designed to meet high environmental quality standards, they will not require added environmental control modifications as generally described herein.) Wheat starch industry firms and plant locations are shown in Table 1-3.

Major wheat starch processing plants are typically small affiliates of diversified corporate operations. Flour milling operations are generally a main part of the total company business, and the wheat starch processing plants utilize low grade flours and second-clears from these mills. In all existing plants, wheat starch processors are closely connected with a flour milling operation as their sources of raw materials.

Table I-3. Wheat starch industry firms and plant locations, 1973

	Estimated Capacity Cwt/day
Centennial Mills Spokane, Washington	
Plants: Portland, Oregon	1,000
Spokane, Washington	1,000
General Mills Minneapolis, Minnesota	
Plant: Keokuk, Iowa	1,000
Midwest Solvent Co. Atchison, Kansas	
Plant: Atchison, Kansas	100
New Era Co. Arkansas City, Kansas	
Plant: Arkansas City, Kansas	750
A. E. Staley Decatur, Illinois	
Plant: Columbus, Ohio	1,500
Loma Linda Riverside, California	
Plant: Riverside, Cal.	NA
<u>New Plants to be Operating in 1974 :</u>	
Pillsbury Minneapolis, Minnesota	
Plant: Minneapolis, Minn.	2,000
Far-Mar-Co. Hutchinson, Kansas	
Plant: Hutchinson, Kansas	Pilot Plant

Wheat starch processing produces two major products: wheat starch per se and vital wheat gluten. The former is used as a minor source of industrial starch (corn starch is the major U.S. industrial starch). Vital wheat gluten, used to enhance the baking quality of various bakery products, is a highly valued byproduct, and for some firms, it is considered more significant than wheat starch.

Level of Integration and Diversification

Wheat starch processing plants are typically affiliated and/or vertically integrated with much larger grain milling industry firms, especially flour milling companies. In the wheat starch industry, General Mills and Pillsbury represent dominant diversified companies. Centennial Mills and Far-Mar-Co are leading milling companies. A. E. Staley Manufacturing is a leading corn wet milling company.

Wheat starch processors or their parent companies are not generally integrated to the wheat grower level. Grain milling companies generally acquire processing grains in commodities markets, but hydro-processing plants (e.g., Pillsbury) may utilize whole grain wheat with high protein content and may seek a supply of the desired varieties of processing wheat through grower contracts.

Wheat starch and gluten products are intermediate products used in further manufacturing processes. The U.S. production of these products serves only domestic markets directly, although the parent organizations or users of these input products may be involved in international production and marketing. The U.S. is a net importer of wheat starch and gluten products.

2. Types of Plants

The sizes and locations of wheat starch plants were presented in Table I-3 above. Generally located in wheat producing areas, essentially all plants are adjacent to flour mills and use the low grades of flour and second-clears from the flour mills as primary raw materials.

Most wheat starch plants (excluding the two new plants scheduled for production in 1974) are relatively old, and industry technology has remained basically unchanged until recently. In its new plant, Pillsbury will introduce major technological changes--generally referred to as hydro processing or the wet processing of wheat. Pillsbury will process whole wheat to secure vital wheat gluten as the primary product (rather than wheat starch). Far-Mar-Co is also introducing major technological changes in its pilot plant operation which are believed similar to Pillsbury's wet processing method. The new operations should be regarded as new types of plants in the industry.

Neither investment nor operating cost and revenue data for new plants are available. Such cost data are proprietary, and operating data are not yet known. Pillsbury has described its new operation as a multi-million dollar facility, and its capacity is estimated at about twice the typical wheat starch processing plant capacity of 1,000 cwt/day.

3. Number of Plants and Employment

As shown in Table I-3, the wheat starch processing industry has seven plants with two new facilities expected to come on stream in 1974. Employment data were estimated as described next.

Employment data for the industry, a relatively minor segment of SIC 2046--Corn Wet Milling, are reported in Census of Manufactures data within those of the larger segment. Because they cannot be accurately extrapolated, DPRA estimated employment for a representative model plant (i.e., 1,000 cwt. per day) from an engineering synthesis of manpower requirements. It was estimated that a representative plant requires about 20 employees. Fifteen (15) or 75 percent are production workers, and the remainder are general administrative, office and sales personnel.

Total employment in the wheat starch processing industry would, then, equal about 140 to 150 (20 employees per plant multiplied by 7 existing plants). This estimate excludes the two new plants scheduled for operation in 1974. These plants would increase estimated employment to about 200.

4. Relationship of Segment to Total Industry

Wheat starch processing, classified by Census of Manufactures as a sub-segment of the Corn Wet Milling industry (SIC 2046) is a relatively minor economic sub-segment of this SIC group (see Section A 4 above). (Well over 95 percent of the employment and value of shipments of SIC 2046 are attributable to corn wet milling operations which were previously studied by EPA.) The seven wheat starch plants represent a total employment of only about 150 employees, and their value of shipments are approximately \$17 million.

While wheat starch operations appear relatively minor in SIC 2046, their principal products--wheat starch, and especially vital wheat gluten--have important industrial and food processing (primarily baking) applications. Furthermore, recent technological breakthroughs (e.g. hydro processing) hold promise for potential major growth by this industry.

Thus, this industry is relatively small, but its importance to overall food processing operations and its expected growth lend it significance in SIC 2054.

5. Likely Impacted Segments

The wheat starch processing industry's operations are such that the industry would be severely impacted if private effluent treatment systems are eventually required. (1) The industry's end products are characteristically high-volume and low value added. (2) The higher valued vital wheat gluten product makes up only 14 percent of the processed input. (3) The high volume product, wheat starch, is but a minor industrial starch product that could not successfully compete if its costs are appreciably increased.

Potential impacts may be partially offset, however. Though differential pollution control impacts may be significant among plant sizes, the fact that most plants discharge into municipal systems will reduce the potential impacts which could otherwise result from EPA control guidelines. Too, unless low cost pollution control technologies were designed, it is unlikely that new small-scale plants would find it profitable to enter production.

II. FINANCIAL PROFILES

Financial data relating to individual cereal breakfast food or wheat starch processing plants are not available. Financial data for the large, publically held companies are available but because many of the companies involved are generally widely diversified corporations, these data cannot be used to reflect specifically their cereal or wheat starch divisions. However, such data, as summarized below, do reflect the general economic viability of firms involved in these industries.

Given such data limitations, model plant budgets were chosen as the best means of achieving reasonable insights into the financial aspects of various representative operations. Model plant configurations, matched to sizes and product mix characteristics within these industries, were constructed as indicated in Table II-1.

A. Cereal Breakfast Food Segment

1. Plants by Segment

The cereal breakfast food financial profiles considered by DPRA included industry profitability, capital structure, cost of capital, pro forma income statements for model plants, invested capital for model plants and the cost structure of model plants by segment. Much of the information requested by EPA was not generally available; necessarily, then, considerable reliance was placed on the model plant configurations and estimates as shown.

Industry Profitability

A general indication of the financial characteristics of the applicable cereal breakfast food industry is suggested in Table II-2. Industry net profit as a percent of sales, net profit as a percent of net worth, and current ratios provide a general perspective on operating characteristics within this industry segment. (Based in part upon this general industry profitability data, DPRA constructed the model plant profitability data found in Table II-3. (DPRA also utilized general economic data and data realized directly from industry consultants.) In general, the three cereal plant models showed net income after taxes as a percent of sales ranging from 8 to 11 percent.)

Table II-1. Model plant configurations by segment

Segment	Capacity (1,000 lbs/day)	Annual operating days ^{1/}	Annual production (1,000 lbs)
Cereal Breakfast Food			
Small	200	234	46,800
Medium	500	240	117,000
Large	1,200	240	280,800
Wheat starch processing	(1,000 cwt/day)		
Medium	1,000	250	250,000

^{1/} Estimated annual equivalent days of capacity operation, calculated as 260 times 90 percent utilization for cereal breakfast foods. Wheat starch processing operating days based on average days reported in the flour milling industry.

Table II-2. Selected financial data for breakfast cereal companies.

Companies	1972	1971	1970	1968	1963
<u>Net Profit as a Percent of Sales</u>					
Kellogg	8.7	8.2	8.1	8.9	8.8
General Mills	3.4	3.9	2.7	4.4	NA
General Foods	2.7	8.2	4.9	5.8	NA
Quaker Oats	4.4	3.6	4.7	3.9	NA
Ralston Purina	3.4	3.2	3.6	2.9	2.7
Int'l. Multifoods	1.9	1.7	1.7	1.5	1.6
Nabisco	4.5	4.7	4.6	5.4	NA
<u>Net Profit as a Percent of Net Worth</u>					
Kellogg	21.3	20.8	20.3	20.3	22.6
General Mills	12.4	13.2	NA	NA	NA
General Foods	8.4	23.6	NA	NA	NA
Quaker Oats	13.4	10.5	NA	NA	NA
Ralston Purina	13.8	NA	NA	NA	NA
Int'l. Multifoods	8.7	8.4	NA	NA	NA
Nabisco	16.0	15.6	NA	NA	NA
<u>Current Ratio (Current Assets to Current Liabilities)</u>					
Kellogg	2.2-1	2.0-1	2.0-1	2.3-1	2.0-1
General Mills	1.7-1	1.7-1	1.9-1	2.1-1	2.7-1
General Foods	1.9-1	2.0-1	2.0-1	2.0-1	2.2-1
Quaker Oats	2.2-1	2.3-1	2.0-1	2.3-1	NA
Ralston Purina	2.1-1	2.2-1	1.9-1	2.1-1	2.2-1
Int'l. Multifoods	2.0-1	1.7-1	1.7-1	2.0-1	2.3-1
Nabisco	2.0-1	2.3-1	2.1-1	2.3-1	2.3-1

Source: Standard & Poors Stock Reports
Securities and Exchange Commission, 10K Reports

Capital Structure

Capital structure ratios are similarly difficult to estimate for the RTE industry segment; however, the major cereal companies have recently had fixed debt to net worth ratios averaging about .2 to .6. Total liabilities to net worth ratios averaged about .4 to 1.2 in the 197-73 period. Current ratios (current assets to current liabilities--see Table II-2) have averaged about 2.0, ranging from about 1.7 to 2.3 for more than five years.

Cost of Capital

An estimated cost of financing new investment was derived from an analysis of the financial reports of the publicly held companies. This method has an obvious shortcoming, for the companies generally are widely diversified corporations whose earnings and capital structure reflect multi-product operations. No better data for estimating cost of capital are available, however.

The method used to estimate the cost of capital involved a computation of debt and equity ratios to total invested capital and the calculation of five-year averages for dividend yield and earnings on common stock.

The estimated averages were as follows:

	<u>Cereal Industry Ratios</u>
Common equity/Invested capital	.650
Long-term debt/Invested capital	.350
Dividend yield, 5-year average	.034
Earnings on common stock, 5-year average	.059

In estimating the cost of capital, other assumptions were made: long-term interest rates averaged 10.0 percent, the corporate tax rate was 48 percent, and the growth rate in dividends was at least equal to the annual inflation rate, estimated at 5 to 6 percent.

The cost of equities was estimated by the dividend yield method, a simplification of the more complex DCF methodology:

$$k = \frac{D}{P} + g$$

where

k = cost of capital
D = dividend yield
P = stock price
g = growth

The after-tax cost of debt capital was estimated from reported (annual financial reports and financial statistics) company outlays for interest expenses multiplied by .52 -- assuming a 48 percent tax rate. These values were weighted by the respective equity to total asset and total liabilities ^{1/} to total asset ratios.

The average cost of capital for the cereal breakfast foods industry was estimated using the equity and debt data reported earlier as follows:

<u>Dividend Yield Plus Growth</u>	<u>Weight</u>	<u>Cost</u> (%)	<u>Growth</u> (%)	<u>Wt'd Cost</u> (%)
<u>Cereal Breakfast Foods</u>				
Equity	.65	.034	.05-.06	.072-.082
Debt (10.0 x 52%)	.35	.052	--	.018
Ave. Cost of Capital				.09-.10

Based on this procedure, the estimated cost of capital is from 9.0 to 10.0 percent for the cereal breakfast foods industry segment.

Pro Forma Income Statements - Model Plants

Pro forma income statements and financial returns for selected model plants are shown in Table II-3 for the cereal breakfast food segment. The model plant configurations shown are generally representative of operating plants within this industry segment as was described in Section I-A above.

A word of caution: Model plant estimates are based upon the best available information concerning industry practices and procedures. Standard financial ratios and cost-synthesis procedures were necessary when specific information was not available. Model plant estimates are useful guides, but such data should not be used literally for actual operating plants.

^{1/} It is recognized that liabilities contain non-interest bearing liabilities, but its weight is believed to be an adequate proxy for the weight of debt.

In a general overview, as shown in Table II-3, cereal breakfast food plants are capital intensive in absolute terms, but invested capital to annual sales ratios are relatively low compared to those of other manufacturing industries. This factor is especially pertinent in understanding this industry segment relative to other food processing industries.

Direct processing expenses, including raw materials (i.e., oats, wheat, corn,) are particularly low relative to sales, approximately 47 to 51 percent as shown in Table II-3. In contrast, indirect expenses are relatively high, about 29 percent, because of marketing and sales costs. The cereal breakfast food industry generally allocates about 13 percent of sales to advertising and promotion. Though probably representative of various packaged foods industries' costs, 13 percent is generally high for other food and kindred products industries.

Annual Profits After Taxes. The medium (500,000 lbs/day) model plant shows a net income of about \$6.2 million on sales of \$58.5 million, or 10.5 percent on sales. The small and large model plants have comparable net income to sales percentages of about 8.0 percent and 11.0 percent, respectively. Relatively minor scale economies are apparent.

Another general indication of profitability is net income after tax as a percent of invested capital. This measure ranges from about 16 to 20 percent for the three cereal breakfast food model plants as shown in Table II-3. This rate is relatively higher than the average of all industrial firms.

Annual Cash Flow. Model plant data show moderately high, 11 to 13 percent, annual cash flows (after-tax income plus depreciation) for the cereal breakfast foods industry in relation to sales (Table II-3). Depreciation allowances as a percent of invested capital range from 4.5 to 4.9 percent for the cereal model plants. These percentage estimates are nominal in relation to all manufacturing industries, but due to the capital intensive-ness of the industry, depreciation allowances add substantially to the cash flow position. Cereal plants generally have relatively long production life-expectancy for frequent modernization improvements are made.

Invested Capital - Model Plants

Investment was estimated for each of the model plants by two primary methods: replacement value and book value. Data availability constraints most affected the method used, but both replacement values (1972) and book values (1972) were estimated for all cereal model plants as shown in Table II-4. Furthermore, estimated salvage values are also presented, and these estimates are subsequently used in plant closure analyses.

Table II-3. Pro forma income statements and financial returns for selected model cereal plants by size

	Small 200,000 lbs/day		Medium 500,000 lbs/day		Large 1,200,000 lbs/day	
	\$000	(%)	\$000	(%)	\$000	(%)
Invested capital ^{1/}	15,470		33,500		75,500	
Annual sales	23,400	100.0	58,500	100.0	140,400	100.0
Direct expenses						
Raw materials	5,101	21.8	11,993	20.5	28,782	20.5
Labor	725	3.1	1,521	2.6	3,510	2.5
Packaging	2,621	11.2	6,201	10.6	14,461	10.3
Freight	1,942	8.3	4,739	8.1	11,232	8.0
Other manufacturing expenses	1,427	6.1	3,276	5.6	8,003	5.7
Subtotal	11,816	50.5	27,730	47.4	65,988	47.0
Indirect expenses						
Warehousing	585	2.5	1,346	2.3	3,510	2.5
Marketing and sales	4,516	19.3	10,998	18.8	26,956	19.2
General and administration	2,036	8.7	4,622	7.9	9,828	7.0
Subtotal	7,137	30.5	16,966	29.0	40,294	28.7
Total operating expenses	18,953	81.0	44,696	76.4	106,282	75.7
Depreciation	700	3.0	1,596	2.7	3,698	2.6
Interest (long-term)	164	.7	351	.6	702	.5
TOTAL COSTS	19,817	84.7	46,643	79.7	110,682	78.8
Net income before tax	3,583	15.3	11,857	20.3	29,718	21.2
Net income after tax	1,863	8.0	6,166	10.5	15,453	11.0
Cash flow	2,563	11.0	7,762	13.3	19,151	13.6
Net income before tax as a percent of invested capital	--	23.2	--	35.4	--	39.4
Net income after tax as a percent of invested capital	--	12.0	--	18.4	--	20.5

^{1/} Includes working capital

Table II-4. Estimated replacement, book and salvage values for model plants by segment

Segment and Model Plant	Replacement Value (\$000)	Book Value (\$000)	Salvage Value (\$000)
<u>Cereal Breakfast Food</u> ^{1/}			
200,000 lbs/day	\$ 21,145	\$15,470	\$ 8,390
500,000 lbs/day	46,450	33,500	17,340
1,200,000 lbs/day	105,525	75,500	38,010

^{1/} Base data available for cereal plants were book value estimates. Other values derived from these values as explained in text.

The model plant financial data utilized, in part, the published financial data for publicly held cereal breakfast foods companies found in the Securities and Exchange Commission's 10K Reports. Stock reports, such as published by Standard and Poors, were also used. These data reflect the principal overall economic operations of these companies.

Although neither individual plant nor unique product data may be determined from the above sources, it is generally possible to construct model plant information which reflects basic underlying economic factors. Further, in some cases, domestic and international operations are separated. Some division data, for example, cereal operations, may be reported.

From such information, DPRA derived model plant book value estimates of invested capital, including working capital, depreciation, interest and other cost interrelationships. As previously stated, such data are only suggestive of specific plant operations. Care should be taken in applying the data to actual operations.

Reported book values of established firms generally understate the current replacement value for similar facilities because of their accumulated depreciation of assets and the higher current costs of construction. Thus, one should not assume that a relatively new or proposed plant would necessarily achieve the same rates of return to capital as are shown in Table II-3. If replacement investment costs rather than book values are used, the return to capital is reduced by about 5 percent as is later discussed in Chapter VI.

Replacement values (and salvage values) as also shown in Table II-5, were estimated, in this case, using book values as a starting point. The following assumptions and procedures were involved:

Capital Cost Item	% of Total Cost	Estimated Percentage Relationships		
		Replace. Value	Book Value	Salvage Value
Land	3%	100%	100%	100%
Buildings	32	150	100	10
Equipment	65	175	100	10
Working Capital	--	100	100	100

In general, land and working capital components were assumed equal in terms of replacement, book and salvage values. Land values were subjectively valued on a replacement cost basis and held constant. Reported book values vary markedly among companies and precise plant data were unavailable. Buildings and equipment, however, had estimated replacement costs greater than book values; estimated salvage values were much lower than book values.

Table II-5. Summary of after-tax net income, return on invested capital, return on sales and cash flows of model plants by segment.

Segment and Model Plant	Net Income (After-tax profit)			
	Total	As a % of		Cash Flows
		Invested Capital	As a % of Sales	
	(\$000)	(%)	(%)	(\$000)
<u>Cereal Breakfast Foods</u>				
200,000 lbs/day	1,863	12.0	8.0	2,563
500,000 lbs/day	6,166	18.4	10.5	7,762
1,200,000 lbs/day	15,453	20.5	11.0	19,151

The following book values were estimated for the three model cereal breakfast food plants.

<u>Capital Cost Item</u>	<u>Model Plant</u>		
	<u>Small</u>	<u>Medium</u>	<u>Large</u>
	-----(\$1,000)-----		
Land	\$ 270	\$ 600	\$ 1,400
Buildings	2,800	6,400	14,900
Equipment	5,700	13,000	30,100
Working Capital	<u>6,700</u>	<u>13,500</u>	<u>29,100</u>
Total Invested Capital	15,470	33,500	75,500

Based on these estimated book values and the above replacement value and salvage value assumptions relative to book value, the estimates in Table II-5 were derived.

Cost Structure - Model Plants

The cost structure of the model plants, as depicted in Table II-3 above, is reflected in part by comparing line items as a percent of sales. For example, direct raw materials costs for cereal plants were estimated at about 20 to 22 percent of sales. Usually raw materials costs represent a much higher proportion of total sales in food processing industries.

Indirect expenses, including warehousing, marketing (selling) and general and administrative expenses are relatively high in the breakfast cereal industry which has traditionally been very consumer-market oriented with sales heavily dependent on advertising. The low relative cost of raw materials can be attributed partially to these high marketing-distribution cost factors.

2. Distribution of Data

A summary of after-tax income, return of invested capital, return on sales and estimated annual cash flows for the cereal model plants is presented in Table II-5. These estimates generally reflect relatively minor production economies of scale. The larger operations tend to have higher profit rates as a percent of invested capital, a condition less pronounced as a percent of sales. Overall, all sizes of model plants shown appear exceptionally viable in the economic factors indicated. The proportion of costs shown for marketing and distribution is essentially constant among the model plants. There are perhaps greater economies of scale in marketing-distribution vs. production, but this relationship cannot be demonstrated with known data.

External as well as internal economic factors also condition a firm's ability to finance new investment. Individual firm capital investment financing depends, in part, on the overall economic condition of both its industry and the national economy.

The general economic outlook for the next few years has been clouded by the uncertainties surrounding economic policies, the critical shortages of many basic resources, and political instabilities. The U.S. economy has, at times, faced the possibility of direct wage and price controls, with or without rationing, but with a virtually certain shortage of critical materials. Under these conditions, rates of economic growth, inflation and capital spending are subject to speculative thinking. The economy may undergo adjustments to present conditions by relying largely on market pressures to cope with scarcities, inflation and problems of growth.

3. Ability to Finance New Investment

The ability of a firm to finance new investment for pollution abatement is a function of several critical financial and economic factors. In general terms, new capital must come from one or more of the following sources: (1) funds borrowed from outside sources; (2) new equity capital through the sale of new common or preferred stock; (3) internally generated funds -- retained earnings and the stream of funds attributed to depreciation of fixed assets.

For each of the three major sources of new investment, the most critical set of factors is the financial condition of the individual firm. For debt financing, the firm's credit rating, earnings record over a period of years, stability of earnings, existing debt-equity ratio and the lenders' confidence in management will be major considerations. New equity funds through the sale of securities will depend upon the firm's future earnings as anticipated by investors, which in part reflect past earnings records. The firm's record, compared to others in its own industry and to firms in other similar industries, will be a major determinant of the ease with which new equity capital can be acquired. In the comparisons, the investor will probably look at the trend of earnings for the past five or so years as well as the future environment the firm faces. Internally generated funds depend upon the margin of profitability and the cash flow from operations. In publicly held corporations, stockholders must be willing to forego dividends in order to make earnings available for reinvestment.

Heavy demands for capital funds have been expected by both public and private organizations to compensate for resource and product shortages. Federal, state and local regulatory actions have added to capital and resource demands. These conditions will keep upward pressures on money rates. In addition, inflation will push interest rates higher as lenders demand a larger inflation premium. Capital funds are likely to be available, in the next few years, but their rates may rise above the historic high

levels of 1969-70 when long-term, high grade corporate bonds yielded 9 to 10 percent. The cost of financing new investment will be high compared to the 1950's and early 1960's.

Section II-A-1 discussed the profitability, capital structure and cost of capital for the cereal segment under consideration. In summary, the cereal breakfast food industry has recorded generally high rates of profit and the large-diversified corporate structure suggests a strong capability for financing new investments. Both internal funds and external sources of capital are generally available to this industry segment. The prospects for industry growth relative to the total economy are good, as cereal food demands have generally increased despite higher costs of production and higher prices to consumers. Cereal products have partially replaced even higher cost food stuffs which cannot be supplied as readily or as economically as cereal based products within the food industry as a whole.

Another important financial consideration in the breakfast cereal industry involves the market share relationships that were described above, for they imply that new firm entry is difficult. Existing firms with established market shares could more likely obtain financing from external sources. Marketing and sales costs within the cereal industry are exceptionally high relative to all manufacturing industries. Thus, though a new plant might readily develop production capability, market penetration would prove difficult.

B. Wheat Starch Processing Segment

DPRA generally utilized the same procedures for estimating wheat starch model plant financial measures as it used for the cereal breakfast food plant models.

Financial data for wheat starch processing operations are extremely difficult to estimate. Reported company data apply to total corporate operations of which wheat starch processing is usually but a minor part. In most cases, wheat starch plants utilize low grade flours from affiliated milling operations. For this reason it might be said that the financial capability of a plant to install pollution control facilities is linked to the overall financial condition of the parent company. However, because not all plants are financially integrated with other grain milling operations, attention was focused on the wheat starch plant as an independent unit.

The model plant financial characteristics were developed from engineering and economic cost synthesis methods. Model plant data were estimated in part from plant visits and from other contacts with industry sources. Only limited data were available from secondary data sources.

1. Plants by Segment

The wheat starch processing industry plants as depicted in this analysis are similar in their production processes.

The two new plants under construction should be treated as a different segment because of their technological changes. The proposed effluent guidelines are expected to apply to the new plants, but their waste flow characteristics and associated treatment requirements may differ. (The new Pillsbury plant has been designed with regard to meeting high environmental control standards; the Far-Mar-Co pilot plant will discharge into a municipal waste treatment system during the trial operating period. No definite waste treatment plans have been announced by Far-Mar-Co for full-scale production.) Operating data were not available for these new plants.

Industry Profitability

Historically, the grain mill products industry in general has had average net profit to sales ratios of about 1.8 to 3.6 percent and net profit to net worth ratios of about 8.0 to 11.9 percent. These ratios are generally below averages reported for all manufacturing industries.

The model plant analysis estimated that the wheat starch processing segment has about a 3.9 percent net profit to sales ratio as shown in Table II-6. Although this ratio is higher than the grain mill industry's range, it remains comparable. This estimate and its derivation are discussed further below.

Capital Structure

The wheat starch processing financial data cannot be extrapolated from available sources, but the flour milling industry in general is broadly comparable. In this case, fixed debt to net worth ratios have ranged from about 0.2 to 0.4, and total liabilities to net worth have been from about 0.6 to 1.0 since the late 1960's. Current ratios have had average ranges from about 1.8 to 2.2 since 1968.

These general indicators suggest that grain milling firms are moderately strong financially and can expand operations without seriously impairing their underlying financial ratios. Such average indicators should be used with caution, however, for individual plants may differ significantly from such averages.

Table II-6. Pro forma income statement and financial return for a selected model wheat starch plant.

	Capacity 1,000 Cwt./day	Percent of sales
	(\$000)	
Invested capital ^{1/}	770	29.7
Annual sales	2,590	100.0
Direct		
Raw materials	2,100	81.1
Labor	115	4.4
Heat and power	5	.2
Subtotal	2,220	85.7
Indirect expenses	112	4.3
Total operating expenses	2,332	90.0
Depreciation	36	1.4
Interest (long-term)	27	1.0
TOTAL COSTS	2,395	92.5
Net income before tax	195	7.5
Net income after tax	101	3.9
Cash flow	130	5.0
Net income before tax as a percent of invested capital	--	25.3
Net income after tax as a percent of invested capital	--	13.1

^{1/} Includes working capital.

Cost of Capital

The estimated cost of financing new investment was based on an analysis of the financial reports of publicly held companies in the grain milling industry. Such data generally represent diversified corporations whose earnings and capital structure reflect multi-product operations, but specific segment data were unavailable.

Estimates of debt and equity ratios to total invested capital and average dividend yields and earnings in the grain milling industry were as follows:

	<u>Milling Industry Ratios</u>
Common equity/Invested capital	.670
Long-term debt/Invested capital	.330
Dividend yield, 5-year average	.031
Earnings on common stock, 5-year average	.072

In estimating the average cost of capital, DPRA assumed that long-term interest rates were at 10.0 percent, the corporate tax rate was 48 percent, and the growth rate in dividends was at 5 to 6 percent.

DPRA also utilized the dividend yield method for estimating the cost of equity capital under the following procedure:

$$k = \frac{D}{P} + g$$

where k = cost of capital (equity portion)
D = dividend yield
P = stock price (average)
g = growth rate

The above methods and financial data yielded the average cost of capital for the wheat starch processing industry as follows:

<u>Dividend Yield plus Growth</u>	<u>Weight</u>	<u>Cost</u>	<u>Growth</u>	<u>Wt'd cost</u>
Wheat Starch Processing				
Equity	.67	.031	.05-.06	.071-.081
Debt (10.0% x 52%)	.33	.052	--	.017
Ave. Cost of Capital				.088-.098

As indicated, the composite average cost of capital ranged from .088 to .098 for the wheat starch processing industry segment. In subsequent analyses, a .09 percent average rate was used.

Pro Forma Income Statements - Model Plant

Pro forma income statements and estimated financial returns for the wheat starch processing model plant are as shown in Table II-6. These data reflect a moderate level of invested capital for a "typical" plant. In this case, direct operating expenses are by far the dominant (86 percent of sales) cost category, and raw materials (clears and low-grade wheat flour -- plus whole wheat in new plants) account for most of this direct operating cost. Available data indicated that indirect expenses are generally low -- only 4 to 5 percent of sales.

Annual Profits After Taxes. The model plant analysis estimated a 3.9 percent net income (after taxes) to sales relationship. This percentage is comparable to the average return on sales for most grain mill products industries. Net income after tax as a percent of invested capital was approximately 13 percent as shown in Table II-6. These ratios reflect moderate rates of return in relation to all manufacturing industries.

Annual Cash Flow. The wheat starch plant cash flow as a percent of sales was estimated at about 5 percent (Table II-6). Straight-line schedule depreciation allowances, which contribute to cash flow, accounted for about 1.4 percent of this 5 percent. Depreciation allowances also represent 4.2 percent of the overall invested capital, a nominal measure for most manufacturing industries.

Invested Capital - Model Plant

Investment requirements for a prevalent technology wheat starch plant were estimated using the replacement value method (1972 basis). Engineering cost synthesis techniques were used to establish land, site preparation, building and equipment investment costs. Book value and salvage value measures were estimated from the "replacement value" and reflect the probable age and condition of existing plants. These estimates are shown in Table II-7.

The invested capital replacement cost estimates for a 1,000 cwt/day model plant were as follows:

<u>Capital Cost Item</u>	<u>Model Plant:</u> <u>1,000 cwt/day</u> <u>(\$1,000)</u>
Land	15
Buildings (Incl. storage)	180
Equipment	445
Working Capital	400
Total Invested Capital	1,040

Table II-7. Estimated replacement, book and salvage values for the wheat starch model plant

Segment and Model Plant	Replacement Value (\$000)	Book Value (\$000)	Salvage Value (\$000)
<u>Wheat Starch Processing 1/</u>			
1,000 cwt/day	1,040	770	520

1/ Base data for the representative wheat starch processing plant were developed via engineering cost-synthesis of a model plant involving replacement values. Other values were derived from this estimate (1972 costs) as explained in text.

The estimated book and salvage values reported in Table II-7 reflect the same relative relationships to replacement costs (by category) as was reported above for the cereal plants. Both wheat starch and cereal plants have been long established and each industry requires the periodic replacement and modernization of worn equipment. The book value estimate was used to calculate model plant returns on invested capital. Replacement and salvage values were used for the impact analyses in Chapter VI.

Cost Structure - Model Plant

The cost structure of the model wheat starch plant is reflected in Table II-6 above by analyzing cost items as a percent of sales. Since one model plant is shown, plant comparisons are not possible. The wheat starch model plant does reflect, however, an exceptionally high raw materials cost as a percent of sales, i.e. about 80 percent.

The indirect expenses of the plant, including marketing and sales costs are quite low. Wheat starch and gluten products serve as inputs into other manufacturing processes; consequently, sales costs are minimal and products are generally sold on a private treaty basis.

2. Distribution of Data

A summary of other financial characteristics, including after-tax income, return on invested capital, return on sales, and estimated annual cash flow for the model plant are as shown in table II-8. These data reflect moderate returns both on sales and on invested capital. Differences among plants are not known, but the model plant is believed representative of this industry segment.

3. Ability to Finance New Investment

A general discussion of factors affecting a firm's ability to finance new investment was presented in section II-A-3 above. Industry-wide and general economic conditions as well as an individual firm's economic prospects affect capital fund availability and money rates.

In broad terms, the wheat starch processing industry has not been regarded as an exceptionally profitable industry. The main strength of the industry is its ties to large flour and other grain mill products firms, e.g., General Mills, Pillsbury, Centennial Mills, and A. E. Staley. Thus, a plant's ability to finance capital investments will depend in large part on its relationship to larger flows and other grain mill firms. In general terms, the prospects for such moderate capital investments are favorable. Doubtless, too, much will depend on the outlook for principal wheat starch processing products, especially vital wheat gluten. That is, new investments would hinge on productive output expectations in relation to investment.

Table II-8. Summary of after-tax net income, return on invested capital, return on sales and cash flows of model plants by segment.

Segment and Model Plant	Net Income (After-tax profit)			
	Total	As a % of Invested Capital	As a % of Sales	Cash Flows
	(\$000)	(%)	(%)	(\$000)
<u>Wheat Starch Processing</u>				
1,000 cwt/day	101	13.1	3.9	137

The technological developments in progress (i.e., wet processing of whole wheat) might limit capital availability for the installation of additional prevalent waste treatment technology in the wheat starch processing industry. As is later discussed, anticipated waste water treatment requirements are a probable deterrent to entry for any plant which may be required to install its own treatment system.

III. PRICING

A. Price Determination

Product markets and product price determinants differ for the cereal breakfast foods and the wheat starch processing industries.

The cereal breakfast food industry prepares its products for their ultimate delivery and sales primarily to retail consumer markets. Consequently, these goods are packed for such markets at the processing plant, regardless of whether intermediate wholesalers, jobbers or other distributors become involved in the marketing-distribution chain. Any marketing-promotion program designed for a particular product line is also usually coordinated at the processor level.

On the other hand, wheat starch processing products (wheat starch and vital wheat gluten, principally) are produced as intermediate raw materials which require further processing. Most "customers" are industrial buyers such as the paper industry and the baking industry. In general, little or no promotional efforts are involved, and primary products are generally undifferentiable among processors.

1. Cereal Breakfast Food Segment

The total value of cereal breakfast foods shipped by all producers was \$925 million in 1972. Industry sales, including other products, were over \$1 billion. Ready-to-eat cereals are the principal products prepared, and based on 1972 Census of Manufactures data, the following approximate volumes and values of product were shipped:

<u>Type of Cereal</u>	<u>Estimated Quantity (mil. lbs.)</u>	<u>Estimated Value (\$ mill.)</u>
<u>Ready-to-Eat</u>		
. Corn flakes & other	518.2	235.5
. Wheat flakes & other	479.7	206.6
. Oat breakfast foods	494.0 ^{1/}	168.0 ^{1/}
. Rice breakfast foods	212.4	141.3
. Other, including baby cereals	226.5	113.0
Subtotal	1,930.8	864.4

^{1/} Estimate by DPRA

<u>Type of Cereal (con'd)</u>	<u>Estimated Quantity (mil. lbs.)</u>	<u>Estimated Value (\$ mil.)</u>
<u>Hot Cereals</u>		
. Farina & other wheat	126.4	36.9
. Rolled oats & oatmeal	178.7 ^{1/}	23.3
. Other (incl. undesignated)		
Subtotal	305.1	60.2
 Total	 2,235.9	 924.6

^{1/} Estimate by DPRA

Implicit prices may be derived from the quantity and value data shown (i.e. the ready-to-eat cereals as a whole have an indicated value of about \$.448 per pound). However, because these product quantities and values include interplant transfers, the computed averages tend to understate finished product values. Based largely on the Census data, an average price of \$.50 per pound was used in the model plant analysis.

Within the basic product categories identified above, the cereal industry produces many breakfast cereal products, in varying package sizes and in similar, but differentiable, product forms. Ready-to-eat cereals, for instance, generally produced from one or more of the basic grains--corn, oats, wheat and rice--may be flaked, puffed, extruded, or shredded. They may be plain or coated with sprays of sugar, vitamins, and minerals to fortify and/or sweeten the product.

The industry has, recently, greatly increased natural cereal production, but because this segment usually has no process waste waters, it is not included in this study.

In general terms, no more than 4 percent of the total crop of oats, wheat, corn, rice or barley is used for cereal production; thus, the industry is neither constrained by nor able to dominantly influence these basic commodities markets.

An important marketing characteristic of the cereal breakfast food industry is its aggressive advertising and sales promotion programs. To promote consumer preference for individual product brands, cereal makers spend about 13% of their cereal sales revenue for advertising. Such promotion has resulted also in the proliferation of products. Over 150 cereal brands have been produced in the last twenty years. Many new products, especially breakfast cereals with relatively higher protein content, have been recently introduced.

A recent development which may ultimately be consequential to industry marketing practices is the Federal Trade Commission's pending action against Kellogg, General Mills, General Foods, and Quaker Oats, the four leading cereal firms. The FTC has charged the firms with violations of Section 5 of the Federal Trade Commission Act in order to inflate prices artificially, maintain excessive profits, limit product innovation, and lessen competition. Allegedly, such intentions are furthered by intensive trademark promotions, restrictive allocation of shelf space, and misleading advertising practices, and have resulted in the four firms realizing a shared industry monopoly of over 90 percent of the U.S. ready-to-eat cereal market. The FTC charges, also, that the companies introduce cereal brands differing but superficially only to maintain their market shares. The industry believes that FTC success in the action could have far reaching effects: the licensing of brand names and trademarks on a royalty-free basis for a specified period, the prohibition of future acquisitions, restrictions on promotional activities, and divestiture requiring the sale of plants and equipment to competitors.

Obviously such conditions would seriously affect industry marketing and sales and, probably, pricing policies and would be determinants in industry responses to EPA pollution control guidelines. DPRA was, naturally, unable to assess such effects. Its meetings and correspondence with the Cereal Institute trade association concerning the present study noted the industry's concern in its consequent decision not to provide DPRA with industry composite cost data.

DPRA's model plant cost data, therefore, were derived by a cost-synthesis procedure which employed the generally well-documented cost relationships found in published records. Further information would be desirable.

2. Wheat Starch Processing Segment

Wheat starch processing involves the manufacture of starch and gluten from residual low-grade wheat flour ("clears" or "second clears"). Although different grades of starches are produced among plants, product differentiation is minimal. Given a specified quantity of input, the following approximate yields and product values are obtained.

<u>Product/Input</u>	<u>Percent</u>	<u>Value/Cwt</u> ^{1/}
Flour Clears	100	
Starch	70	\$4-7
. Prime Pearl	(28)	
. Granules ^{2/}	(42)	
Vital Gluten	14	\$25-39
Fat, Fiber, Soluble Protein ^{3/}	16	

^{1/} DPRA estimated a composite value of sales of \$10.36 per hundred-weight of flour (clears) processed.

^{2/} Input for gelatinized starch (for corebinders, wallpaper paste, etc.) and distillers' products.

^{3/} Used as distillers' products. Value included with starch.

DPRA estimated an average value of sales of \$10.36 per cwt. of flour clears processed. Starch prices generally vary in response to competing starch prices (primarily corn starch which comprises over 90 percent of the U. S. industrial starch). Vital gluten is a highly valued ingredient in the baking industry, both because of its generally high protein content, and because of its, perhaps more important baking quality enhancement features (e.g., it improves texture and results in less breaking).

Industry pricing reflects the exceptionally high proportion of raw material costs (81 percent in processing relative to sales value), that makes the industry especially sensitive to variations in wheat and related flour costs. Wheat starch prices are largely determined by corn starch prices. Vital wheat gluten prices may be changed independently of the starch prices, but they are subject to demand conditions in the baking industry. Other by-product values are generally minor.

B. Potential Price Changes

With the proposed imposition of pollution controls and associated treatment costs, an obvious question is whether impacted firms will be able to increase prices to recover incremental waste treatment costs. In competitive markets, an individual firm is not likely to raise prices unless most industry firms do so.

The imposition of the EPA treatment controls discussed in this study should not result in industry-wide price increases because most industry plants presently utilize municipal waste treatment facilities and are not affected by the EPA controls. Other considerations should be acknowledged, however.

All RTE cereal plants will incur additional costs. The tendency to raise prices correspondingly, however, is partly negated by the availability of other substitute breakfast cereals which will not incur costs.

Compensatory price increases in the wheat starch processing industry will be determined by the dominant effect of corn starch prices. Vital gluten prices are more capable of change and are responsive to bakery demand levels. Finally, because wheat starch processing plants are widely dispersed, individual firm price changes may occur to reflect specific locational pricing advantages.

The prospective price changes that are both "needed" to recover incremental pollution control costs and that are most likely within each industry segment are discussed further in Chapter VI, below.

IV. ECONOMIC IMPACT ANALYSIS METHODOLOGY

The economic impact analysis will utilize the basic industry information developed in Chapters I-III plus the pollution abatement technology and costs to be provided by Environmental Protection Agency. The impacts to be examined include:

- Price effects
- Financial effects
- Production effects
- Employment effects
- Community effects
- Other effects

The required impact analysis will not be a simple sequential analysis, but rather, it will be composed of a number of interacting steps with feedback. The schematic of the analytical approach is shown in Figure IV-1. Due to the fundamental nature of potential plant shutdowns (financial and production effects) to the other impacts, the analysis will emphasize plant closure analysis.

The fundamental aspect of the impact analysis is similar to that normally done for any capital budgeting study of new investments. The problem is one of deciding whether a commitment of time or money to a project is worthwhile in terms of its expected benefits. The problem is complicated by the fact that benefits and investments accrue over time and that, in practice, no analyst is sufficiently clairvoyant or physically able to reflect all of the required information, which, by definition, is necessary for projections of the future. In the face of imperfect and incomplete information and time constraints, the industry segments were described in the form of financial budgets of model plants. Key non-quantifiable factors were incorporated into the analytical thought process to interpret the quantified data. Actual financial results will differ from the model results, and these variations were considered in interpreting the findings based on model plants.

A. Fundamental Methodology

The fundamentals for analysis are basic to all impacts. The core methodology is described here as a unit with the specific impact analysis discussed under the appropriate heading following this section.

The core analysis for this inquiry was based upon the synthesizing of the physical and financial characteristics of the various industry segments within representative (model) plants. Estimated financial profiles and cash

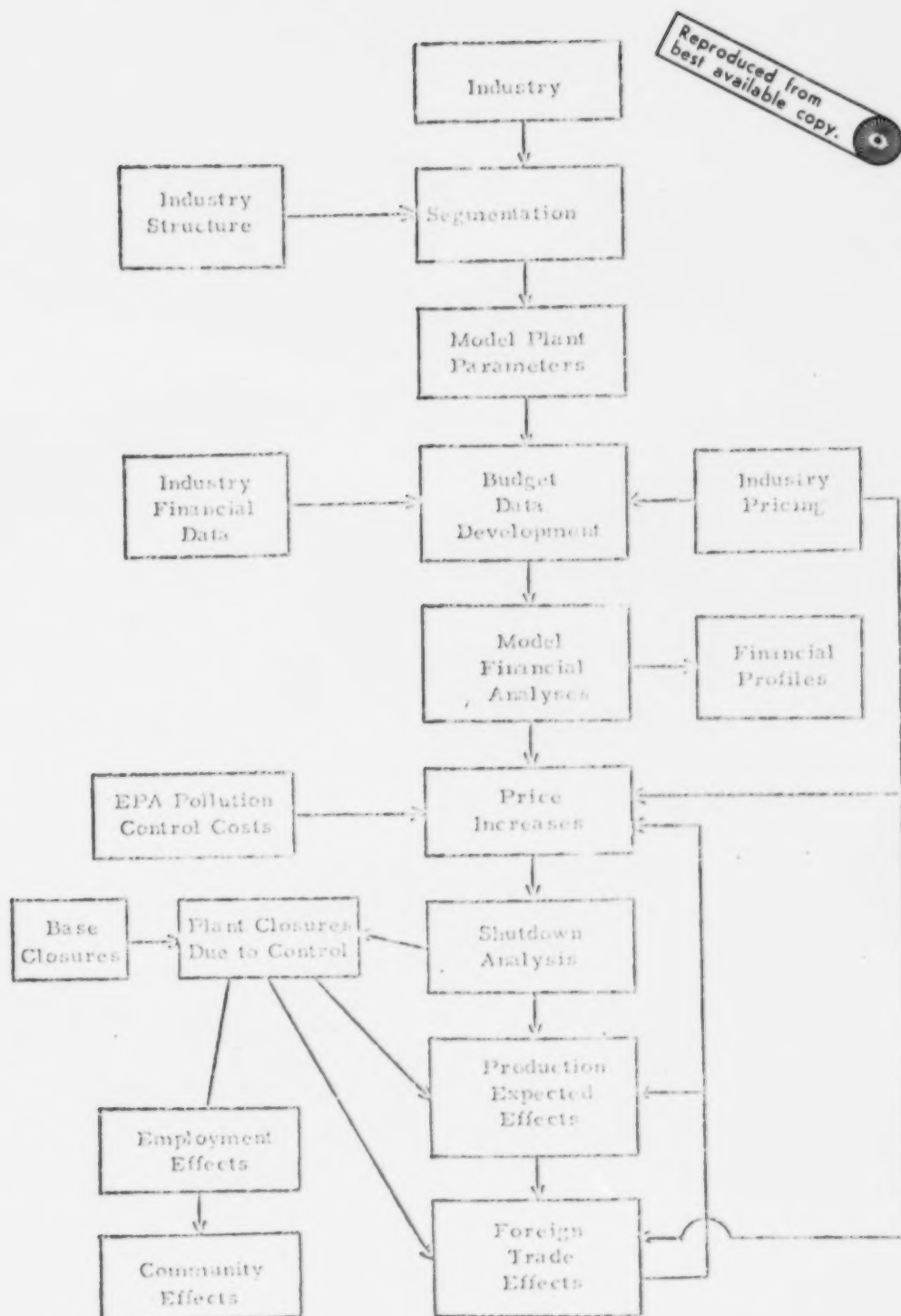


Figure IV-1. Schematic of impact analysis of effluent control guidelines.

flows were presented in Chapter II. The primary factors involved in assessing the financial and production impact of pollution control were profitability changes which are a function of the cost of pollution control and the ability to pass along these costs in higher prices. In reality, closure decisions are seldom made on a set of well-defined and documented economic rules. They include a wide range of personal values, external forces such as the ability to obtain financing, or the consideration of the production unit as an integrated part of a larger cost center where total costs must be considered.

Such circumstances include but are not limited to the following factors:

1. The owner-operator lacks knowledge concerning the actual financial condition of the operation due to faulty or inadequate accounting systems or procedures. This is especially likely to occur among small, independent operators who do not have effective cost accounting systems.
2. Plant and equipment are old and fully depreciated and the owner has no intention of replacing or modernizing them. He continues production as long as he can cover labor and materials costs and/or until the equipment deteriorates to an irreparable and in-operative condition.
3. Personal values and goals associated with business ownership override or ameliorate rational economic rules. This complex of factors may be referred to as a value of psychic income.
4. The plant is a part of a larger integrated entity and it either uses raw materials being produced profitably in another of the firm's operating units wherein an assured market is critical or, alternatively, it supplies raw materials to another of the firm's operations wherein the source of supply is critical. When the profitability of the second operation offsets the losses in the first plant, the unprofitable operation may continue indefinitely because the total enterprise is profitable.
5. The owner-operator expects that losses are temporary and that adverse conditions will dissipate in the future. His ability to absorb short-term losses depends upon his access to funds, through credit or personal resources not presently utilized in this particular operation.
6. There are very low (approaching zero) opportunity costs for the fixed assets and for the owner-operator's managerial skills and/or labor. As long as the operator can meet labor and materials costs, he will continue to operate. He may even operate with gross revenues below variable costs until he has exhausted his working capital and credit.

7. The value of the land on which the plant is located is appreciating at a rate sufficient to offset short-term losses, funds are available to meet operating needs, and opportunity costs of the owner-operator's managerial skills are low.

These factors are generally associated with proprietorships and closely held enterprises rather than publicly held corporations.

While the above factors are present in and relevant to business decisions, common economic rules are generally considered sufficient to provide useful and reliable insight into potential business responses to required investment and operating costs in pollution control facilities.

The following discussion presumes investment in pollution control facilities. However, the rules presented apply to on-going operations. In the simplest case, a plant will be closed when variable expenses (V_c) are greater than revenues (R) since by closing the plant, losses can be avoided.

A more probable situation is where $VC < R$ but revenues are less than variable costs plus cash overhead expenses (TC_c) which are fixed in the short run. In this situation, a plant would likely continue to operate as contributions are being made toward covering a portion of these fixed cash overhead expenses. The firm cannot operate indefinitely under this condition, but the length of this period is uncertain. Basic to this strategy of continuing operations is the firm's expectation that revenues will increase to cover cash outlay. Identification of plants where $TC_c > R$, but $V_c < R$ leads to an estimate of plants that should be closed over some period of time if revenues do not increase. However, the timing of such closures is difficult to predict.

The next level is where $TC_c < R$. If $TC_c < R$, it is likely that plant operations will continue so long as the capitalized value of earnings (CV), at the firm's (industry) cost of capital, is greater than the realizable value (S) of sunk plant investment. If $S > CV$ or $CV - S < 0$, the firm could realize S in cash and reinvest and be financially better off, assuming reinvestment at least at the firm's (industry) cost of capital.

Computation of CV involves discounting the future earning flows to present value through the discounting function:

$$NPV = \sum_{n=1}^t A_n(1+i)^{-n}$$

where

NPV = net present value

A_n = future after-tax income in n^{th} year or salvage value in year t

i = discount rate at cost of capital

n = number of conversion periods, i.e., 1 year, 2 years, etc.

It should be noted that a more common measure of profitability is return on investment (ROI) where profits are expressed as a percent of invested capital (book value), net worth or sales. These measures should not be viewed so much as different estimates of profitability as compared to present value measures but rather as an entirely different profitability concept.

The data requirements for ROI and NPV measures are derived from the same basic financial information although the final inputs are handled differently for each.

1. Returns

For the purposes of this analysis, the returns for the ROI analysis were defined as pre-tax and after-tax income and for the NPV analysis as after-tax cash proceeds. The computation of each is shown below:

Pre-tax income = $(R - E - I - D)$

After-tax income = $(1 - T) \times (R - E - I - D)$

where

T = tax rate

R = revenues

E = expenses other than depreciation and interest

I = interest expense

D = depreciation charges

Interest in the cash proceeds computation was omitted since it is reflected in the discount rate, the after-tax cost of capital. Depreciation was included in the NPV measure only in terms of its tax effect, and it was then added back to obtain cash flow.

A tax rate of 22 percent on the first \$25,000 income and 48 percent on amounts over \$25,000 was used throughout the analysis. Accelerated depreciation methods, investment credits, carry forward and carry back provisions were not used due to their complexity and special limitations.

2. Investment

Investment is normally thought of as outlays for fixed assets and working capital. However, in evaluating closure of an on-going plant with sunk investment, the value of that investment is its liquidation or salvage value (opportunity cost or shadow price) ^{1/}. For this analysis, sunk investment was taken as the sum of the liquidation value of fixed assets plus the net working capital (current assets less current liabilities) tied up by the plant (see Chapter II for values). This same amount was taken as a negative investment in the terminal year.

The rationale for using total shadow priced investment was that the cash flows do not include interest expenses with interest charges reflected in the weighted cost of capital. This procedure requires the use of total capital (salvage value) regardless of source. An alternative would be to use as investment, net cash realization (total less debt retirement) upon liquidation of the plant. (In the single plant firm debt retirement would be clearly defined. In the case of the multi-plant firm, delineation of debt by plant would likely not be clear. Presumably this could be reflected in proportioning total debt to the individual plant on some plant parameter such as capacity or sales.) Under this latter procedure, interest and debt retirement costs would be included in the cash flows.

The two procedures yield similar results if the cost of capital and interest charges are estimated on a similar basis. The former procedure, total salvage value, was used because it gave reasonable answers and simplified both the computation and explanation of the cash flows and salvage values.

Replacement investment for plant maintenance was taken as equal to annual depreciation, a procedure which corresponds to operating policies of some managements and serves as a good proxy for replacement in an on-going business.

Investment in pollution control facilities were determined from estimates provided by EPA. Only incremental values were used to reflect in-place facilities and only the value of the land for control was taken as a negative investment in the terminal year, i.e., pollution control equipment was assumed to have no salvage value.

^{1/} This should not be confused with a simple buy-sell situation which merely involves a transfer of ownership from one firm to another. In this instance, the opportunity cost (shadow price) of the investment may take on a different value.

The above discussion refers primarily to the NPV analysis. Investment used in estimating ROI was taken as invested capital--book value of assets plus net working capital.

3. Cost of Capital - After Tax

Return on invested capital is a fundamental notion in U. S. business. It provides both a measure of actual performance of a firm as well as expected performance. In the latter case, it is also called the cost of capital. The cost of capital is defined as the weighted average of the cost of each type of capital employed by the firm, or in general terms, equities and interest bearing liabilities. There is no methodology that yields the precise cost of capital, but it can be approximated within reasonable bounds.

The cost of equities was estimated by the dividend yield method, a simplification of the more complex NPV methodology. The dividend method is:

$$k = \frac{D}{P} + g$$

where

k = cost of capital
D = dividend yield
P = stock price
g = growth

The after tax cost of debt capital was estimated from reported (annual financial reports and financial statistics) company outlays for interest expenses and was multiplied by .52 -- assuming a 48 percent tax rate. These values were weighted by the respective equity to total asset and total liabilities^{1/} to total asset ratios.

Estimated cost of capital for the industries under study are contained in Chapter II.

4. Construction of the Cash Flow

The cash flow to be used in the analysis of BPT (Best Practical Technology) and BAT (Best Available Technology) effluent control will be constructed as follows:

1. Sunk investment (salvage market value of fixed assets plus net working capital) taken in year t_0 , assumed to be equivalent to 1976,
2. After tax cash proceeds taken for years t_1 to t_n

^{1/} It is recognized that liabilities contain non-interest bearing liabilities, but its weight is believed to be an adequate proxy for the weight of debt.

3. Annual replacement investment, equal to annual current depreciation taken for years t_1 to t_n .
4. Terminal value equal to sunk investment taken in year t_n .
5. Incremental pollution control investment taken in year t_0 for 1977 standards and year t_6 for 1983 standards.
6. Incremental pollution expenses taken for years t_1 to t_n for 1977 standards and years t_7 to t_n for 1983 standards if additive to the 1977 standards. ⁿ
7. Replacement investment taken in year t_n on incremental pollution investment in BPT on assumption of life of facilities as provided by EPA.
8. No terminal value of pollution facilities to be taken in year t_n . Land value were assumed to be very small and/or zero, unless the costs provided indicated otherwise.

The length of the cash flow depended upon the life of the pollution control technology provided by EPA. The length of the cash flow equaled the life of the control equipment specified for 1983 installation.

Construction of the cash flows for analyzing new source standards were similar to those for BPT and BAT, excepting plant investments. Costs and returns were based on current values.

B. Price Effects

As shown in Figure IV-1, price and production effects are interrelated. In fact, the very basis of price analysis is the premise that prices and supplies (production) are functionally related variables which are simultaneously resolved, thus the feedback loop shown in Figure IV-1.

Solution of this requires knowledge of demand growth, price elasticities, supply elasticities, the degree to which regional markets exist, the degree of dominance exerted by large firms in the industry, market concentration exhibited by both the industry's suppliers of inputs and purchasers of outputs, organization and coordination within the industry, relationship of domestic output to the world market, existence and nature of complementary goods, cyclical trends in the industry, current utilization of capacity, and the exogenous influences upon price determination (e.g., governmental regulation).

In view of the complexity and diversity of factors involved in determination of the market price, a purely quantitative approach to the problem of price effects was not feasible for this study. Hence, the simultaneous considerations suggested above were made. The judgment factor was heavily employed in determining the supply response to a price change and alternative price changes employed.

Application of the above NPV procedure to pollution control costs yielded the present value of pollution control costs (i.e., investment plus operating cost less tax savings excluding interest expenses). Given this, the price increase required to pay for pollution control were calculated as

$$P = \frac{(PVP)(100)}{(1-T)(PVR)}$$

where:

P = required percentage increase in price

PVP = present value of pollution control costs

PVR = present value of gross revenue (sales)
starting in the year pollution control
is imposed

T = tax rate appropriate following imposition
of pollution control

The next step evaluated the required price increases against expectations regarding the ability to raise prices. As pointed out above, this was a function of a number of factors. In cases where a few large plants represented the bulk of production, their required price increase set the upper limit. For some products in this study, other factors were overriding. For example, wheat starch price changes are largely constrained by corn starch price changes. Also, relative pollution control cost impacts on the segments studied vs. other industries were important. From this analysis, which was quantitative, an initial estimate of expected price increases was made.

Following this, the initial shutdown analysis (production curtailment) was made. The decrease in production was evaluated in the light of the impact on prices, and if warranted by production decreases, the expected price increase was revised upward.

C. Shutdown Analysis

The basic shutdown analysis was based upon the technique described above under Section A and the expected price increase from the preceding step. In addition to this analysis, analyses were made to establish estimated plant closures without imposition of pollution control, the so-called "base line" closures. This analysis involved the same financial analysis technique, without pollution control, and factored in other information such as trends in the industry itself and in competing products.

Based on the results of the NPV analysis of model plants, likely closures were identified where $NPV < 0$. (The net present value analysis procedure is only one measure of potential closures, and other conditions regarding the industry were also assessed.) Segments or plants in the industry were equated by interpolation to the appropriate model results. Mitigating items, such as association with a complex, captive raw material sources, unique market advantages and existing in-place controls and the ability to finance new non-productive investment were factored in qualitatively to obtain an estimate of likely closures. When BAT costs differed from BPT costs, closure estimates were made for each condition.

Analysis of new source standards were of the conventional NPV feasibility analysis based upon expected prices. In this case, it was a matter of whether new plants would be built without vs. with effluent controls.

The impact of these closures were evaluated next (see Figure IV-1). If production impacts were of sufficient magnitude, the expected prices were re-evaluated and the shutdown analysis repeated.

D. Production Effects

Potential production effects include changes of capacity utilization rates, plant closures and the stagnation of industry growth. Plant closures may be offset in total or in part by increases in capacity utilization on the part of plants remaining in operation. Expected new production facilities were estimated. The end result was the estimated production under the conditions presumed for the above closure analysis.

The estimated production under these expectations was fedback into the price analysis to verify or revise expected price changes.

E. Employment Effects

Given the production effects of estimated production curtailments, potential plant closings and changes in industry growth, a major consideration arises

in the implications of these factors upon employment in the industry. The employment effects stemming from each of these production impacts in terms of jobs lost were estimated using the model plant information.

Locations of closed plants with respect to their importance to locations labor base were evaluated. This analysis was directed toward re-employment potentials.

F. Community Effects

The direct impacts of job losses upon a community are immediately apparent. However, in many cases, plant closures and cutbacks have a far greater impact than just the employment loss. These multiplier effects are reflected in evaluating payroll losses and income multipliers.

In addition to these direct and indirect impacts on communities, broader potential impacts must be evaluated. The importance of the industry segments to the overall economy was assessed.

G. Other Effects

Other impacts such as direct balance of payments effects were qualitatively analyzed.

V. POLLUTION CONTROL REQUIREMENTS AND COSTS

The water pollution control standards, technology, and costs used in this analysis were furnished by the Effluent Guidelines Division of the Environmental Protection Agency from materials developed in part for the Environmental Protection Agency by Sverdrup and Parcel and Associates (S&P). The basic data constructed by S&P were adapted to the types and sizes of plants designated in this analysis.

Three effluent guidelines were considered:

- BPT - Best Practicable Control Technology Currently Available, to be achieved by July 1, 1977
- BAT - Best Available Pollution Control Technology Economically Achievable, to be achieved by July 1, 1983
- NSPS - New Source Performance Standards, apply to any source for which construction starts after the publication of the proposed regulations for the Standards

A technical document describing the recommended technology for achieving the three guidelines will be published as a separate report by EPA. To avoid duplication and possible confusion, no technical descriptions of BPT, BAT and NSPS guidelines are given in this report. The interested reader is referred to EPA's technical report for technology descriptions.

A. Pollution Control Requirements

The Best Practicable Control Technology currently available (BPT) and the Best Available Technology (BAT) guidelines for cereal breakfast foods and wheat starch processing subcategories of the grain milling industry are summarized in Tables V-1 and V-2 respectively. Also NSPS guidelines are shown in Table V-3 and these guidelines are applicable for new plants which are constructed after the promulgation of the proposed standards.

The achievement of the BPT and BAT guidelines necessitate the application of suitable treatment practices. In the draft Development Document by S&P specific possible wastewater treatment practices were identified for each subcategory of the grain milling industry being studied to achieve effluent reduction corresponding to both BPT and BAT levels.

Table V -1. BPT pollution control: effluent reduction attainable through the application of best practicable control technology currently available

Industry Segment	BPT proposed standards		pH
	BOD (lbs/1000 lbs.)	Suspended solids (lbs/1000 lbs.)	
Ready-to-eat cereal manufacturing	0.40	0.40	6-9
Wheat starch and gluten manufacturing	2.0	2.0	6-9

Source: EPA and Sverdrup & Parcel and Associates

Table V-2. BAT pollution control: effluent reduction attainable through the application of best available technology economically achievable

Industry Segment	BAT proposed standards		pH
	BOD (lbs/1000 lbs.)	Suspended solids (lbs/1000 lbs.)	
Ready-to-eat cereal manufacturing	0.20	0.15	6-9
Wheat starch and gluten manufacturing	0.50	0.40	6-9

Source: EPA and Sverdrup & Parcel and Associates

Table V-3. NSPS pollution control: effluent reduction attainable through the application of New Source Performance Standards ^{1/}

Industry Segment	NSPS Proposed Standards		
	BOD (lbs/1,000 lbs)	Suspended Solids (lbs/1,000 lbs)	pH
Ready-to-eat cereal manufacturing	0.20	0.15	6-9
Wheat starch and gluten manufacturing	1.00	1.00	6-9

Source: EPA and Sverdrup and Parcel and Associates

^{1/} BPT and BAT technologies were applied in the impact analysis to estimate achievement of these standards.

In each case, the BAT proposed practices assumed compliance with the BPT practices initially, followed by additional treatment to attain the higher standard.

A brief summary of indicated treatment practices proposed to meet the tentative guidelines by coresponding industry subcategory is presented below.

1. Ready-to-eat Cereal Manufacturing

General Requirements - Those plants discharging directly to surface waters must undertake major pollution abatement activities to meet effluent limitations. Since most wastewater from ready-to-eat cereal manufacturing stems from clean-up operations, the influence upon raw waste characteristics through the use of in-plant controls is not anticipated. Treatment of the entire wastewater stream will be necessary as follows:

1. Collection and equalization of flow
2. Primary sedimentation
3. Nutrient addition
4. Biological treatment using activated sludge or a comparable system
5. Secondary sedimentation

Waste loads could be reduced in some plants if more extensive dry clean-up operations were employed, e.g., sweeping and vacuuming instead of wet washing methods. The wastewater treatment practices proposed to meet the guidelines are basically as follows:

(I) BPT: Equalization and Activated Sludge - Treatment consists of an aerated equalization step with 18-hour detention ahead of the complete-mix activated sludge system and associated chemical feed, sedimentation, and sludge dewatering facilities. (Treatment alternative "B" as reported by EPA)

(II) BAT: Equalization, Activated Sludge, and Deep Bed Filtration - Treatment consists of BPT treatment plus deep bed filtration. (Treatment alternative "D" as reported by EPA)

Industry Experience - At present, only one cereal plant directly discharges process waters to surface waters, and that waste discharge is not treated. The plants municipal sewer system is being expanded and will collect these waters for treatment in the near future. All other cereal plants studied discharge their wastes to municipal systems.

Several plants minimally pretreat process waters prior to discharge to municipal systems. This preliminary treatment usually consists of screening and, occasionally, of settling and skimming. The collected solids are either recovered and dried for animal feed or disposed of by landfill.

One plant in the industry currently provides more extensive pretreatment. This biological pretreatment system consists of a one and one-fourth acre lagoon equipped with mechanical aerators and is designed for a thirty-day detention. Ammonia and phosphoric acid nutrients are added to the high carbohydrate waste stream and all process and sanitary wastes from the plant, including shredded cereal cooking wastes, are treated by the facility.

Another small RTE cereal plant is currently constructing a pretreatment facility designed to treat combined process and sanitary wastes. The facility will consist of two aerated lagoons in series with nutrient addition and provision for recycling between the two lagoons. Additional technical data concerning these latter two plants is presented in the S & P's Development Document for EPA.

Since RTE wastewaters are compatible with municipal system requirements, no federal prerequisites for discharge into municipal systems are required (although local and state laws may require pretreatment). However, as external wastewater treatment use charges increase (primarily due to charges by municipalities when existing systems are upgraded), external pretreatment facilities are likely in order to reduce this cost burden.

2. Wheat Starch and Gluten Manufacturing

General Requirements - It is doubtful that any major reductions in waste loads can be achieved through in-plant controls or through modifications of existing starch plants. Treatment of the entire waste stream will be required as follows to meet the effluent limitations:

1. Collection and equalization of flow
2. pH neutralization
3. Primary sedimentation
4. Biological treatment using activated sludge or a comparable system
5. Final separation of solids by sedimentation prior to discharge

Since product yield is economically crucial to wheat starch and gluten plants, most manufacturers already attempt to maximize solids recovery in the starch refining operations by thickening and centrifugation. To meet the proposed effluent guidelines, the treatment practices recommended are as follows:

(1) BPT: Equalization and Activated Sludge - Treatment includes 18 hours of aerated equalization ahead of the complete-mix sludge system. (Treatment alternative "B" as reported by EPA.)

(11) BAT: Equalization, Activated Sludge, and Deep Water Filtration. In this proposed system, deep water filtration is added to the proposed system, deep water filtration is added to the proposed DPT system above. (Treatment alternative "D" as reported by EPA.)

Industry Experience - Of the seven wheat starch and gluten manufacturing plants, six plants discharge their wastes to municipal systems. One of these six plants provides pretreatment, and another is building a pretreatment facility. The seventh plant uses its starch effluent in a distillery operation from which there is a direct discharge to surface water. (This plant is constructing a treatment plant for the distillery wastes.) Two new plants will commence operation in the near future, and both anticipate the generation of much lower volumes of wastewater than existing plants. One plant will accomplish this by drastically reducing water requirements; the other plans a total recycle system.

Discussions by DPRA with industry representatives have indicated a growing and widespread concern within the industry that municipal system treatment charges will increase sharply, e.g., about a three-fold increase on average. The industry, consequently is evaluating both pretreatment and private treatment systems which might be used to augment and/or replace municipal treatment systems for a lower average treatment cost over time.

B. "Typical" Effluent Control Costs

The additional investment and operating costs required of a "typical" plant, in each plant-size and segment group, to achieve indicated performance standards were specified in the Development Document. Typical plants, as defined by EPA, are indicated as follows:

In the ready-to-eat cereal segment, a wide range of plant production capacities exists. Therefore three hypothetical plants were constructed with the following capacities:

1. A "small" plant with a capacity of 200,000 pounds per day.
2. A "medium" plant with a capacity of 500,000 pounds per day.
3. A "large" plant with a capacity of 1,200,000 pounds per day.

These three plant sizes are considered representative of the ready-to-eat subsegment of the cereal breakfast food industry. In the small plant capacity range, (50,000 pounds per day to 300,000 pounds per day) those plants nearer 50,000 pounds per day capacity are typically natural and hot cereal plants. For this reason, a plant of near the lower extreme of the small plant capacity range was not included in DPRA's analysis.

The largest plants are commonly referred to as super size plants. Kellogg and Post plants are examples of super size operations with both producing over 1,000,000 pounds per day (estimated production is between 1,000,000 and 1,400,000 pounds per day).

The seven wheat starch and gluten plants constitute a narrow range of plant capacities. Therefore one hypothetical plant was constructed:

One plant with an average daily raw material capacity of 100,000 pounds of flour.

The additional investment required by "typical" plants to achieve the indicated performance standards is shown in Table V-4. The model plants were selected as the most representative impacted size categories of plants, and it is believed that representative plant data, as provided, were adequate to project the overall expected impacts.

Table V-3. Incremental effluent control costs for "typical" ready-to-eat cereal, and wheat starch and gluten plants

Plant size	BPT ^{1/}		BAT ^{1/}	
	Investment	Annual operating costs ^{2/}	Investment	Annual operating costs ^{2/}
<u>Ready-to-eat cereal:</u>				
Small (200,000 lbs/day)	527,900	58,000	35,400	8,000
Medium (500,000 lbs/day)	811,800	93,700	63,500	15,600
Large (1,200,000 lbs/day)	1,277,500	148,100	134,200	25,800
<u>Wheat starch & gluten:</u>				
Medium (1,000 cwt/day)	964,300	126,900	31,700	7,600

Sources: Compiled by DPRA from data provided by EPA as reported in the S & P Development Document.

^{1/} BPT and BAT controls were briefly described in the text. In both the RTE and the wheat starch processing segments, BPT control costs refer to the alternative "B" treatment strategy and BAT control costs refer to the alternative "D" treatment strategy as contained in the Development Document. BAT costs are incremental above BPT costs as shown.

^{2/} Annual operating costs include operating and maintenance costs plus energy and power costs as shown in the Development Document. Interest (capital) costs and depreciation are not included.

VI. IMPACT ANALYSIS

The imposition of direct discharge effluent guidelines on the ready-to-eat cereal manufacturing and wheat starch and gluten manufacturing industries are not likely to have significant direct impacts on either industry because in both industries most plants currently discharge waste waters into municipal sewer systems where treatment of these wastes is adequate.

With the exception of one wheat starch plant, all plants in this segment are currently connected to municipal waste treatment facilities and are paying associated user charges. (For the plant with direct discharge, the starch effluent is first used in a distillery operation. Wastes from the distillery operation are discharged to receiving water. The plant is constructing a waste treatment facility.) The plants may leave the municipal systems for, at least, two reasons, however: (1) a municipal system may refuse continued service or (2) plant management may decide that long-term treatment costs are lower under plant treatment facilities. In either case, the focus of this analysis indicate the prospective economic impacts associated with installing BPT and BAT treatment systems as proposed.

As was indicated in the preceding chapter, only one cereal plant was reported to discharge process wastes directly to receiving water (untreated). It was further noted that the city's municipal sewer system is being expanded to collect the wastes.

The proposed "BPT" and "BAT" standards will, therefore, apply to only one plant (soon none) in each industry. However, consideration was also given to the potential impact of New Source Performance Standards (NSPS) which would apply to any new firms entering these industries. The wheat starch processing industry will be seriously affected by the NSPS guidelines. (This study assumes that the NSPS standards are equal to the BAT standards. The estimated costs for BAT are subsequently used for assessing the new source potential impacts.)

The ready-to-eat cereal and wheat starch manufacturing segments are discussed separately, and the following impacts are considered.

- . Price effects
- . Financial effects
- . Production effects
- . Employment effects
- . Community effects
- . Balance of payment effects

Because of the limited applicability of the proposed effluent guidelines, the above effects are minimal. Attention was devoted, therefore, to the model plant financial analyses. On the whole, neither industry is adversely impacted by the proposed standards and associated treatment requirements.

A. Cereal Breakfast Food Segment

As an overview, the following factors are pertinent to this analysis:

- . Only 1 of 17 existing RTE cereal plants currently discharges directly into surface waters.
- . The single plant disposing of wastes directly into surface waters will connect to a municipal sewer system which is correspondingly expanding its capacity.
- . Plant sizes range from about 200,000 pounds per day to well over 1,000,000 pounds per day capacity.
- . Four firms with over 90 percent of the U. S. total sales of cereal products dominate the industry.
- . Since 16 of the 17 existing plants (soon all 17) discharge waste waters into municipal systems, any expected effluent control impact will have occurred via treatment practices in place prior to the enforcement of the proposed effluent guidelines.

1. Price Effects

Based upon the individual model plant analyses, the required price increases to recover the costs of constructing and operating pollution control facilities are illustrated in Table VI-1. These price changes were calculated as a percent of sales, using a 21-year cash flow. Both treatment costs and revenues were discounted back to year "zero" prior to calculating the percentage price increase required. This increase indicated the change necessary to keep the net present value (NPV) of the plant constant. Price increases required to recover the costs of BPT controls are relatively minor, ranging from .26 percent for the large plant to .62 percent for the small plant. Price increases required for the medium size plants would equal about .4 percent.

Table VI-1. Percent price increase required to pay for incremental pollution control, cereal breakfast food industry.

Size of Plant	BPT above Baseline (%)	BAT above Baseline (%)	BAT above BPT (%)
Cereal breakfast food:			
Small	.62	.65	.03
Medium	.39	.41	.02
Large	.26	.28	.02

Price increases above BPT standards to recover the costs of BAT standards are negligible, ranging from .02 percent for the large plants to .03 percent for the small size plants.

Because only one plant is potentially impacted (and that plant will eventually discharge into a municipal system), industry prices are not expected to increase due to the imposition of direct discharge controls on the RTE cereal industry. Industry competition should overshadow any prospective price change by an individual plant.

Industry costs, however, may be indirectly affected. If municipal treatment systems become more costly because of their expansion or their improved technology to meet higher federal, state or local pollution standards, those costs will presumably be passed to industrial users. Such an eventuality could result in higher product prices. Too, existing firms are evaluating pretreatment systems to avoid prospective surcharges for treatment of industrial wastes. While there is no federal requirement for installing pretreatment systems (because cereal wastes are generally compatible with municipal waste treatment), some state and local regulations may necessitate pretreatment or make pretreatment economically feasible in the near future.

2. Financial Effects

Two primary types of analyses were completed to assess the financial impacts of the proposed pollution control costs on the model plants: (1) profitability impacts and (2) impacts on the present value of the future net income stream.

Profitability impacts include the following:

- . Pre-tax net income
- . After-tax return on sales
- . Pre-tax rate of return on invested capital
- . After-tax rate of return on invested capital
- . Annual cash flow

Basic industry information and model plant financial profiles of the RTE cereal subsegment, as presented in Chapter II, provided the basis for assessing these profitability impacts.

Pre-tax income

The impact of alternative effluent treatment level on pre-tax net income for model cereal plants is illustrated in Table VI-2. The reduction in pre-tax net income due to the imposition of BPT and BAT standards ranges from 1.0 percent for the large plant to a 3.3 percent reduction for the small cereal plant. After-tax income reductions are comparable, ranging from about 0.9 percent to 2.9 percent for the same plants.

Table VI-2. Pre-tax and after-tax income for model cereal plants, assuming no price change

Size of Plant	Pre-tax Income		After-tax Income	
	Baseline (\$000)	BPT (\$000)	Baseline (\$000)	BAT (\$000)
Cereal breakfast food:				
Small	3,583	3,478	1,863	1,815
Medium	11,857	11,690	6,166	6,085
Large	29,718	29,455	15,453	15,323

Return on sales

The after-tax return on sales for model cereal plants is illustrated in Table VI-3. With the imposition of BPT and BAT standards, the reduction in after-tax return on sales ranges from 0.1 percent in the large plant to 0.3 percent in the small. Incomes as a percent of sales for all three plant sizes are negligibly reduced with the imposition of these standards.

Return on invested capital

Return on invested capital before and after tax for model cereal plants is illustrated in Table VI-4. The high after-tax rate of return on invested capital demonstrates the exceptional profitability of the cereal breakfast food industry. After-tax income as a percent of invested capital ranges from a high of 20.5 percent in the large size plant to a low of 12.0 percent for the small size plant.

With the imposition of the BPT and BAT standards after-tax return on invested capital declines 0.7 percent in the small plant and 0.6 percent in the large plant. The decline is not serious.

Cash flow

Estimated cash flows (after-tax income plus depreciation) for the model cereal plants are illustrated in Table VI-5. Cash flows, at baseline, range from 16.6 percent of average invested capital for the small plant to 25.4 percent for the large plant. Cash flows are not adversely affected by the imposition of the BPT and BAT standards.

Net present value (NPV)

Another measure of the financial viability of a plant is the net present value (NPV) of its projected streams of cost and revenues. Using this analysis, DPRAs assessed the likelihood of continued plant operation versus plant closure. In discounting the cash flow using a discount rate equivalent to a firm's cost of capital, positive NPV's would indicate the likelihood of continued plant operation whereas negative NPV's would infer a probable plant closure. To complete this analysis, the following assumptions were made.

1. The existing plants have sunk investments, but they could be disposed of today for a salvage value and their recovered capital reinvested elsewhere if their cereal function were discontinued. However, only 10 percent of the estimated replacement cost is assumed recoverable for this industry. This relatively low value is estimated because cereal plants are moderately capital intensive and equipment would have little salvage value outside the industry.

Table VI-3. Pre-tax and after-tax return on sales for model cereal plants, assuming no price change

Size of Plant	Pre-tax Income		After-tax Income	
	Baseline (%)	BPT (%)	Baseline (%)	BAT (%)
Cereal breakfast food:				
Small	15.3	14.9	8.0	7.8
Medium	20.3	20.0	10.5	10.4
Large	21.2	21.0	11.0	10.9

Table VI-4. Pre-tax and after-tax rate of return as a percent of average invested capital for model cereal plants, assuming no price change.

Size of Plant	Pre-tax Income		After-tax Income	
	Baseline (%)	BPT (%)	BAT (%)	BAT (%)
Cereal breakfast food:				
Small	23.2	21.7	21.6	11.3
Medium	35.4	34.1	33.9	17.7
Large	39.4	38.4	38.2	19.9

Table VI-5. Estimated cash flow on average invested capital for model cereal plants, alternative effluent treatment levels assuming no price change.

Type & Size of Plant	Baseline		BPT		BAT	
	(\$000)	(%)	(\$000)	(%)	(\$000)	(%)
Cereal breakfast food:						
Small	2,563	16.6	2,541	16.4	2,537	16.4
Medium	7,762	23.2	7,722	23.1	7,714	23.0
Large	19,151	25.4	19,085	25.3	19,072	25.3

2. Revenues and expenses are assumed to remain constant over time, i.e., 20 years of operation.
3. The estimated cost of capital for the industry is 9.0 percent. The net present value of model cereal plants before and after the imposition of alternative effluent treatment standards are shown in Table VI-6.

Since NPV's of all examined plants are positive, the above analysis indicated that all respective plants are capable of bearing the cost of both BPT and BAT controls. No plant closures were suggested by this model plant analysis.

The fact that sixteen of seventeen existing plants discharge waste waters to municipal systems is a direct indication that no plant is likely to shut-down due to pollution control requirements, per se.

3. NSPS Effects

Other effects of environmental controls on the cereal industry are the increased cost burden for new plants in the industry and potentially lower industry growth. NSPS, new source performance standards, if applicable, would partially deter entry.

To assess the probable impacts on a new plant, replacement investment costs (versus book value investment costs) were used to perform similar profitability analyses as shown above. New plants entering the industry are expected to realize a lower after-tax rate of return on invested capital (ROI). Also, lower net present values (NPV) are expected. Comparative ROI and NPV data for the three RTE model plants as shown in Table VI-7 illustrate these effects. The new source model plants remain economically viable following the imposition of BAT control standards.

4. Other Effects

The remaining types of impacts--production effects, employment effects, community effects and balance-of-payment effects -- are considered insignificant because of the nature of this industry. Sixteen of the seventeen existing plants, as reported in the Development Document 1/ are not affected directly by the guidelines of this study. It should be noted, however, that these plants may incur cost increases from additional surcharges by their respective municipal plants.

1/ Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Animal Feed, Breakfast Cereal, and Wheat Starch, prepared by Sverdrup & Parcel and Associates, Inc. for United States Environmental Protection Agency, April, 1974.

Table VI-6. Net present values of model cereal plants before and after the imposition of alternative effluent treatment standards.

Size of Plant	BPT		BAT	
	NPV of Plant Before Controls	NPV of BPT Controls	NPV of BAT Controls	NPV of Plant After Controls
	(\$000)	(\$000)	(\$000)	(\$000)
Small	13,080	- 687	- 36	12,357
Medium	48,613	-1,078	- 68	47,467
Large	124,469	-1,700	-127	122,642

Table VI-7. Existing plants vs. new source plants with BAT controls, returns on invested capital (ROI) and net present values (NPV), assuming no price increases.

Plant Size	Existing Plants		New Plants	
	ROI (%)	NPV (\$000)	ROI (%)	NPV (\$000)
Small	12.0	13,080	8.3	1,877
Medium	18.4	48,613	12.8	23,550
Large	20.5	124,469	14.2	67,172

B. Wheat Starch Processing Segment

The following assumptions underlay DPRA's analysis of the economic impacts of EPA's effluent control costs on the wheat starch processing industry.

- . Of the seven wheat starch gluten manufacturing plants, six plants currently discharge their wastes to municipal systems.
- . Wheat starch plants connected to municipal systems expect significant treatment cost increases as municipalities upgrade their systems.
- . The seventh plant uses its starch effluent in a distillery operation which directly discharges to surface water. Some question exists as to whether this plant falls under the guidelines proposed for wheat starch processors or under those for a distillery operation (it is also in the process of building a treatment plant for the distillery wastes).
- . The seven existing plants exhibit a fairly narrow range of plant capacities (50,000 lbs to 150,000 lbs) of flour processed per day and have similar waste water characteristics. DPRA's "typical" model plant has an average daily raw material capacity of 100,000 lbs of flour.
- . Major wheat starch processing firms typically have large, diversified operations, and wheat starch processing is a relatively small part of the total corporate business.
- . Little can be done to increase prices of wheat starch unless changes first occur in corn starch prices (corn starch comprises over 90 percent of the U.S. starch usage).

With six of the seven existing wheat starch plants currently discharging waste waters into municipal systems, the industry should not be directly affected adversely by the proposed point-source effluent guidelines. Unfortunately, conditions exist which make a finite judgment impossible.

Impacts could be severe for new plants or for any plant which would discontinue its municipal discharge system. Although private treatment costs as estimated in this report appear prohibitive for existing plants, such an alternative has been under consideration by industry plant managers because of the projected higher municipal treatment charges. As noted elsewhere, technological improvements in the wheat starch-gluten processing industry increase the risks of added capital expenditures within existing plants from a potential rapid obsolescence of prevalent technology. Industry representatives are concerned because the proposed treatment technologies

have not yet been demonstrated within the industry. This adds to the overall uncertainty with which the industry is faced. In essence, then, the industry is relatively more concerned with the proposed point-source guidelines than would at first appear warranted. 1/

1. Price Effects

Based on the individual model plant analysis, the required price increase to recover the costs of incremental pollution facilities is illustrated in Table VI-8. Price changes were calculated using a 21-year cash flow with treatment costs and revenues being discounted back to year "zero" prior to calculating the percentage price increase required. This increase indicated the change necessary to maintain a constant plant net present value (NPV).

The price increase required to achieve BPT standards, according to the model plant analysis, is approximately 8.7 percent for the medium size model plant. An additional incremental price increase of 0.2 percent is required for subsequent implementation of the BAT standards.

An individual plant in the wheat starch processing industry would not be expected to pass-through cost increases of the magnitude indicated, i.e., about 9 percent. However, with essentially all plants anticipating higher waste treatment charges, some price increases are likely. The impacts of 1, 3 and 5 percent price increases were evaluated in the financial and NPV sections below to indicate how price increases might alter a firm's decision to continue operation. An increase of about 5 percent would be possible under anticipated prospects throughout the industry.

The prospective 5 percent average price increase is based on both supply and demand factors. On the cost of production (supply) side, a three-fold increase in municipal waste treatment charges (from a base level of about \$30,000 to \$40,000 average for a medium plant size) are anticipated. This corresponds to a 3 to 4 percent increase in average sales prices to recover these added costs; hence, an industry price increase of this magnitude appears warranted.

On the demand side, two major market demand questions ultimately favor a further price increase. First, wheat starch sales compete directly with corn starch products. Since corn starch comprises over ninety percent of all industrial starch sales in the U.S., wheat starch prices cannot necessarily be raised "as needed." Corn starch supplies (relative to demand) will essentially determine all industrial starch prices. In this respect, only about a 1 to 2 percent increase in starch prices may result from increased water treatment cost pass-throughs. 2/

1/ One plant representative has reported that a land disposal system is under construction and that his plant will soon discontinue its municipal treatment service. Since the proposed guidelines have not been promulgated, there is still uncertainty about the adequacy of this development and/or any requisite changes.

2/ A prior EPA study of the Corn Wet Milling industry indicated that corn starch price increases of this magnitude were expected due to water effluent controls.

Table VI-8. Percent price increase required to pay for incremental pollution control, wheat starch processing industry.

Size of Plant	BPT	BAT	BAT
	Above Baseline	Above Baseline	Above BPT
	(%)	(%)	(%)
Medium	8.7	8.9	.2

Secondly, prospects are favorable that vital wheat gluten market prices might be increased to recover some or all of the anticipated higher waste treatment costs. Approximately half of the value of sales from the wheat starch processing industry is derived from vital wheat gluten products. The demand for gluten has been growing rapidly in both the baking industry and the texturized vegetable protein industry. The U.S. has recently imported about 40 percent of the U.S. demand for gluten with steadily increasing competition for available world supplies. Further, the demand for vital wheat gluten is regarded as price inelastic (no quantitative estimates of price elasticity are known, however). These factors are favorable from the wheat starch processing industry's viewpoint. 1/

While no definitive projection of average potential price increases can be made at this time, the above factors suggest that a significant composite price change may be possible. For example, an 8 to 10 percent increase in gluten prices plus a 1 to 2 percent change in starch prices could result in a composite increase in sales of about 5 percent. A 3 to 5 percent overall price increase, therefore, appears likely throughout the industry based both on supply and demand factors. Because of the potential supply shortages of gluten products for some time into the future, a 5 percent target increase was proposed for this analysis.

2. Financial Effects

Two primary types of analyses were completed to assess the financial impacts of the proposed pollution control costs on the wheat starch model plant: (1) profitability impacts and (2) impacts on the present value of future net income streams.

Profitability impacts include the following:

- . Pre-tax and after-tax
- . After-tax return on sales
- . Pre-tax and after-tax return on invested capital
- . Annual cash flow

The two types of analyses were completed assuming no price increase and with projected 1, 3 and 5 percent increases. 2/ The 1 and 3 percent price increases were examined to illustrate the sensitivity of price (revenue) increases. Expected impacts with a 5 percent price increase resulted in marginal plant operations for plants directly discharging. Without such a price increase, model plants would be expected to close if the proposed BPT and BAT treatment systems were required.

-
- 1/ In contrast, the new wet processing methods are principally designed to produce wheat gluten, and over time, adequate supplies of gluten may be more competitively produced in such plants.
- 2/ The 5 percent composite average price increase is projected. Other composite price (sales) increases are shown to indicate the sensitivity of impacts due to price factors.

Pre-tax and after-tax income

The impact of alternative effluent treatment levels on pre-tax net income for the model wheat starch processing plant is illustrated in Table VI-9. The imposition of BPT standards, assuming no price increase, severely reduced net income from \$195,000 to -\$18,700. The imposition of BAT standards further reduced pre-tax income to -\$29,100. As shown in Table VI-9 also, price increases of either 3 percent or 5 percent would result in positive pre-tax and after-tax incomes. A 1 percent average price (revenue) increase would lower losses but would not produce a positive net income.

Return on sales

The after-tax return on sales for the model wheat starch plant at alternative treatment levels is illustrated in Table VI-10. The returns follow the same general pattern as that established for pre-tax income. Profits are reduced by more than 100 percent with the imposition of BAT and BPT standards. After-tax returns on sales decline from 3.9 percent at baseline to -1.1 percent after the implementation of BPT and BAT standards with no price changes. Again, both 3 and 5 percent price increases would yield a small positive return on sales as is also shown in Table VI-10.

Pre-tax and after-tax return on invested capital

Return on invested capital before and after taxes for the model wheat starch processing plant is illustrated in Table VI-11. After-tax income as a percent of invested capital is 13.1 percent. With the imposition of the BPT and BAT standards, after-tax return on invested capital declined from 13.1 percent to an estimated -1.7 percent. Expected returns on invested capital followed a similar pattern as that for the return on sales. Returns on invested capital after price increases are also illustrated in Table VI-11. In general, none of the price assumptions shown would return the plant to the same profit level as indicated for the baseline case without a price change.

Cash flow

Estimated cash flow (after-tax income plus depreciation) for the model wheat starch plant is illustrated in Table VI-12. Cash flow, at baseline, is 17.8 percent of invested capital. The estimated cash flow is adversely affected after the imposition of the BPT and BAT standards. A 5 percent price increase returns estimated cash flow to a level only slightly higher than attainable at baseline with no price increase.

Net present value (NPV)

Another measure of a plant's financial viability is the net present value (NPV) of its projected streams of cost and revenues. Using this analysis, DPRA assessed the likelihood of continued plant operation versus plant closure. In discounting the cash flow using a discount rate equivalent to

Table VI-9. Pre-tax and after-tax income for model wheat starch processing plant, with selected price changes

Size of Plant	Price Increase ^{1/} (%)	Pre-tax Income			After-tax Income		
		Baseline	BPT	BAT	Baseline	BPT	BAT
		-----(\$000)-----					
Medium	0.0	195.0	-18.7	-29.1	101.0	-18.7	-29.1
Medium	1.0	221.0	7.3	-3.1	120.7	5.7	-3.1
Medium	3.0	272.7	59.0	48.6	148.3	37.2	31.8
Medium	5.0	324.5	110.8	100.4	175.2	64.1	58.7

^{1/} Alternative price increases (assumed) reflect an average composite increase in both starch and gluten products such that sales revenue is increased by the percentage shown. Three levels are shown to indicate the sensitivity of results to price changes.

Table VI-10. Pre-tax and after-tax return on sales for model wheat starch plant, with selected price changes

Size of Plant	Price Increase <u>1/</u>	Pre-tax Income			After-tax Income		
		Baseline	BPT	BAT	Baseline	BPT	BAT
		------(%)-----					
Medium	0.0	7.5	-0.7	-1.1	3.9	-0.7	-1.1
Medium	1.0	8.4	0.3	-0.1	4.6	0.2	-0.1
Medium	3.0	10.2	2.2	1.8	5.6	1.4	1.2
Medium	5.0	11.9	4.1	3.7	6.4	2.4	2.2

^{1/} Alternative price increases (assumed) reflect an average composite increase in both starch and gluten products such that sales revenue is increased by the percentage shown. Three levels are shown to indicate the sensitivity of results to price changes.

Table VI-11. Pre-tax and after-tax rate of return as a percent of average invested capital for model wheat starch processing plants, with selected price changes.

Size of Plant	Price Increase ^{1/}	Pre-tax Income			After-tax Income		
		Baseline	BPT	BAT	Baseline	BPT	BAT
		----- (%) -----					
Medium	0.0	25.3	-1.1	-1.7	13.1	-1.1	-1.7
Medium	1.0	28.7	0.4	-0.2	15.7	0.3	-0.2
Medium	3.0	35.4	3.4	2.7	19.3	2.1	1.8
Medium	5.0	42.1	6.4	5.7	22.8	3.7	3.3

^{1/} Alternative price increases (assumed) reflect an average composite increase in both starch and gluten products such that sales revenue is increased by the percentage shown. Three levels are shown to indicate the sensitivity of results to price changes.

Table VI-12. Estimated cash flow on average invested capital for model wheat processing plant, alternative effluent treatment levels, assuming no price change.

Size of Plant	Baseline		BPT		BAT	
	(\$000)	(%)	(\$000)	(%)	(\$000)	(%)
Medium	137	17.8	65	8.5	56	7.4

a firm's cost of capital, positive NPV's would indicate the likelihood of continued plant operations whereas negative NPV's would infer a probable plant closure. To complete this analysis, the following assumptions were made:

1. The existing plants have sunk investments but they could be disposed of today for a salvage value and the recovered capital reinvested elsewhere if their wheat starch processing function were discontinued. However, only 10 percent of the estimated replacement costs is assumed recoverable for this industry. The relatively low value is estimated because wheat starch processing plants are moderately capital intensive and equipment would have little salvage value in alternative uses outside the industry. Also, most existing wheat starch plants are relatively old.
2. Revenues and expenses are assumed to remain constant over time, i.e., 20 years of operation.
3. The estimated average cost of capital for the industry is 9.0 percent. The net present value of model wheat starch plants, before and after the imposition of alternative effluent treatment standards, is illustrated in Table VI-13.

The imposition of BPT and BAT controls reduced the net present value of the model wheat starch to a negative position in all cases below the 5 percent price increase case. This suggests that this size of plant would not be able to bear the cost of BPT and BAT controls and would probably shut down unless prices increased by about 5 percent. Variations from the model plant case are obviously expected in actuality, but the analysis illustrates the general level of impacts and the sensitivity of price (cost) pass throughs which could affect a plant closure decision.

3. NSPS Effects 1/

New source performance standards (NSPS) equal to BPT and BAT standards as presented above, would apply to any new plant which had a point-source discharge. To assess the probable impacts on such a plant, DPRA analyzed the model plant as described above--but with replacement investment costs vs. book value investment levels as was applied to an existing model plant.

In brief, without significant price increases, a new plant (using prevalent treatment technology) would incur even greater losses than an existing plant because of its higher average investment levels. For such a plant, most importantly, NPV analysis indicates that NPV values, unless prices were increased, would be less than zero.

1/ To assess NSPS effects, estimated pollution control capital and operating costs as shown for BPT and BAT above were applied (in 1977 and 1983 respectively) to approximate NSPS control costs.

Table VI-13. Net present values of model wheat starch processing plant before and after the imposition of alternative effluent treatment standards, with selected price changes

Size of Plant	Price Increase ^{1/}	NPV of Plant Before Controls	BPT		BAT	
			NPV of BPT Controls	NPV of Plant After Controls	NPV of BAT Controls	NPV of Plant After Controls
			-----(\$000)-----			
Medium	0.0	795.3	-1355.5	-560.1	-33.7	-593.8
Medium	1.0	918.7	-1355.5	-436.7	-33.7	-470.4
Medium	3.0	1164.2	-1355.5	-191.3	-33.7	-225.0
Medium	5.0	1410.0	-1355.5	54.6	-33.7	20.9

^{1/} Alternative price increases (assumed) reflect an average composite increase in both starch and gluten products such that sales revenue is increased by the percentage shown. Three levels are shown to indicate the sensitivity of results to price changes.

Other related questions are whether a new source would likely be constructed with increased prices, and if so, at what increased level? Further NPV analysis, as is also summarized in Table VI-14, suggests that a new source would not be profitable even at the 5 percent price increase level. Extrapolation of the data shown indicates that about an 8 percent price increase would be required to attract new plants (using existing, prevalent treatment technology) into the industry.

As was indicated earlier, improved processing technology has been developed in the wheat starch-gluten industry; therefore, some question exists as to the likelihood of new sources using prevalent treatment technology. If prevalent technology is not used, then the proposed NSPS standards may not be a strict barrier to entry into the industry.

No definitive answer can yet be made concerning the latter issues, but the following summary of prospective conditions in the industry is presented as a guide to possible further impacts of the proposed guidelines.

Presently, two new wheat starch-gluten plants are under construction. Both have introduced improved technologies (wet processing techniques with patents pending) that are anticipated to substantially reduce water usage and waste flows. One plant will have a capacity roughly comparable to a 2,000 cwt/day plant (it uses different raw material inputs and has different waste flow characteristics); the second plant is a pilot plant only.

Both plants are expected to come on-stream in the near future, and only then will valid operating data become available to the firms. Thus, it is not yet possible to ascertain future aggregate production and marketing impacts of the plants on existing markets (especially gluten markets). It is known, however, that preliminary feasibility studies for the construction of additional plants by these firms are underway. Final studies would presumably be completed following a trial period of actual operations in the first plants.

4. Other Effects

The remaining point-source related types of impacts--production effects, employment effects, community effects and balance-of-payment effects--are considered minimal. Although six of the industry's seven plants are expected to incur an increase in the cost of operation from increased municipal surcharges, they are not affected directly by the guidelines of this study. Industry reactions to prospective changes in treatment charges are varied, but price increases, especially for gluten, are expected.

Two other wheat starch plants examined by DPRA for this study, both of which have discontinued operation, were Colorado Milling and Elevator Company and Hercules, Incorporated. The Hercules plant processed wheat starch for use in making other Hercules products. It discontinued operation due to location problems and state and local effluent guidelines constraints (Hercules was dumping into a near-by lake). The Colorado firm was not available for direct information concerning their closing.

Table VI-14. Net present value analysis of a new source model wheat starch processing plant before and after the imposition of alternative effluent treatment standards, with selected price changes ^{1/}

Plant Size	Price Increase ^{2/}	NPV of Plant Before Controls	BPT		BAT	
			NPV of BPT Controls	NPV of Plant After Controls	NPV of BAT Controls	NPV of Plant After Controls
			-----(\$000)-----			
Medium	0.0	368.1	-1355.5	-987.4	-33.7	-1021.1
Medium	1.0	491.5	-1355.5	-864.0	-33.7	-897.7
Medium	3.0	763.9	-1355.5	-618.5	-33.7	-652.2
Medium	5.0	982.8	-1355.5	-372.7	-33.7	-406.3

^{1/} NPV analysis utilizing replacement cost investments, and a 9 percent average cost of capital. BPT and BAT control requirements equal to the existing plant proposed standards.

^{2/} Alternative price increases (assumed) reflect an average composite increase in both starch and gluten products such that sales revenue is increased by the percentage shown. Three levels are shown to indicate the sensitivity of results to price changes.

VII. LIMITS OF THE ANALYSIS

The foregoing impact analysis was based upon data and information from industry sources, from published secondary data sources, and from subjective judgment. At various stages, the data utilized are subject to error. The purpose of this final section is to present limits of the analysis in terms of accuracy, range of error and critical assumptions.

A. General Accuracy

Financial information concerned with investments, operating costs and revenues was in general not available for individual plants or firms in the cereal and wheat starch processing industries. Consequently, the financial aspects of the impact analysis were, of necessity, based upon synthesized costs and returns for "representative" model plants within each subindustry studied. The accuracy of the financial data used is difficult to measure; however, it is believed that the data used are representative. Various checks were made to establish the reasonableness of the data used.

The requisite data were developed by DPRA from a variety of sources including published materials from universities and government agencies, previous studies done by DPRA, information obtained from industry sources including trade associations, published financial performance data sources, and from private individuals knowledgeable of the industry. A variety of cross-checks were made using published information from the Internal Revenue Service, Standard and Poors, Dun and Bradstreet and other financial data sources to ascertain whether the simulated performance reflected the performance experience in the respective industries. Based on these cross-checks, it is believed that the model plants are representative and suitable for assessing the incremental impacts of pollution controls.

It is noted that in the recent past the grain commodity markets in general (including corn, wheat and rice) have been exceptionally volatile and record high prices have been established. These prices directly affect the cereal and wheat starch processing industries, and the full repercussions on these industries are not yet known.

Water pollution control costs were provided by EPA (and Sverdrup and Parcel and Associates). These data were developed for typical plants within each subindustry studied. Although DPRA adjusted or scaled these data as described above to reflect the general price level changes, there may be considerable inaccuracy involved.

However, given the accuracy of the pollution control costs, it is believed that the analysis represents a usefully accurate evaluation of the economic impact of the proposed effluent guidelines on the cereal and wheat starch processing industries as they currently exist.

1. Errors in Data

Estimated data error ranges as an average for the industry are as follows:

	<u>Error Range</u> (%)
1. Information regarding the organization and structure of the industry, number, location, and size of plants, and other information descriptive of industry segments	<u>±</u> 5
2. Price information of products and raw materials	<u>±</u> 20
3. Cost information for plant investments and operating costs	<u>±</u> 15
4. Financial information concerning the industries	<u>±</u> 15
5. Salvage values of plants and equipment	<u>±</u> 20
6. Water pollution control costs	Unknown
7. Plant closures	<u>±</u> 5

Critical Assumptions

In order to complete this analysis of the industries within the scope of study established, a variety of assumptions were required. Some critical assumptions were applicable to all segments studied, while others were specific to a given subindustry. The main assumptions deserving further comment are described below.

Representativeness of Model Plants. It is difficult to represent an industry or subindustry with only 1 to 3 model plant situations when there are actually many sizes and types of plants in the industry. In the industries studied, the most difficult one to represent simply was the ready-to-eat cereal industry. No two plants in this industry are alike because numerous end-products and product mixes can be produced. The smaller plants in the industry may not be adequately represented.

Model Plant Cost Data. Secondary or published investment and operating cost data are minimal in the cereal and wheat starch industry. Engineering synthesis techniques had to be relied upon as a basis for constructing most of the model plant cost data. Piecemeal published data and information provided by knowledgeable industry sources were correlated with the engineering data. The resulting model plant data are believed reasonable and representative, but it remains that the data are not based on detailed "book value" statistics.

Prices and Inflation. Because of the tremendous variability in product prices during the past year, 1973 was atypical. Since DPRA lacked sufficient information to construct a profile over time for the operation of the industry, 1972 was taken as a more "normal" year. As a result, the "model" plant financial profiles reflect that year.

It is commonly assumed that both costs and returns will be proportionately affected by inflation to the degree that the impact is offsetting. However, it is noted that pollution control costs are increasing relatively faster than other segments of the economy. Thus, one might question the accuracy of the estimated 1977 and 1983 waste treatment costs relative to other costs and prices.

Cost of Capital

The projected economic outlook for the U.S. economy is fraught with rising inflation, raw material shortages, market uncertainties, etc. Such factors contribute to upward pressures on the cost of debt and equity capital. A 9.0 percent average cost of capital rate was estimated as being most applicable throughout this report. However, both higher (11.0 percent) and lower (7.5 percent) rates were evaluated in a sensitivity analysis of this factor, especially for the wheat starch processing segment. A lower rate used in the NPV analysis reduces the likelihood of plant closure based on the criterion used; a higher rate increases the likelihood of plant closure following the imposition of controls. For example, financing of wheat starch BAT control costs at 7.5, 9.0 and 11.0 percent costs of capital results in NPV's for the baseline model plant are as shown in Table VII-1. Also shown are the NPV's with selected price changes of 1, 3 and 5 percent as were described in Chapter VI.

A further sensitivity analysis involving both the cost of capital assumptions and the price assumptions for an existing model wheat starch plant is as summarized in Table VII-2. In this case, the net present values of an existing model plant are positive with a 5 percent price increase at both the 7.5 and 9.0 percent cost of capital rates. In other words, an existing plant would likely remain in operation if either it was forced off a municipal system or plant management chose to build a private treatment system. However, with less than about a 5 percent average price increase, plant closure would be expected.

Table VII-1. Net present value sensitivity analysis for a new source wheat starch processing plant, BAT standards, with selected costs of capital and selected price changes

Plant Size	Price Increase	Net Present Values -NSPS (BAT controls)		
		Cost of Capital		
		7.5 %	9.0 %	11.0 %
		-----(\$000)-----		
Medium	0.0	-869.1	-1021.1	-1178.9
Medium	1.0	-731.2	-897.7	-1071.2
Medium	3.0	-457.2	-652.2	-857.2
Medium	5.0	-182.6	-406.3	-642.7

1/ Alternative price increases (assumed) reflect an average composite increase in both starch and gluten products such that sales revenue is increased by the percentage shown. Three levels are shown to indicate the sensitivity of results to price changes.

Table VII-2. Net present value sensitivity analysis for an existing wheat starch processing plant, BAT with selected costs of capital and selected price changes

Plant Size	Price Increase ^{1/}	Net Present Values-Existing Plant (BAT controls)		
		Cost of Capital		
		7.0%	9.0%	11.0%
		-----	(\$000) -----	-----
Medium	0.0	-471.5	-593.8	-723.4
Medium	1.0	-333.6	-470.4	-615.7
Medium	3.0	-59.6	-225.0	-401.6
Medium	5.0	215.0	20.9	-187.1

^{1/} Alternative price increases (assumed) reflect an average composite increase in both starch and gluten products such that sales revenue is increased by the percentage shown. Three levels are shown to indicate the sensitivity of results to price changes.

B. Current State of Waste Water Treatment in the Industry

Data on waste water treatment in the industry was obtained from the Development Document and utilized as reported therein.

Salvage Values

Salvage values of buildings, equipment and land will vary greatly from one location to another and with the type and condition of structures and equipment.

In order to avoid problems which would be inherent in attempting to establish differential salvage values, a set of "standard" assumptions concerning salvage values was developed.

- a. Land was salvaged at its 1972 value.
- b. Buildings and equipment for conventional plants were salvaged at a net amount equivalent to 10 percent of their 1972 replacement value.
- c. Net operating capital was recovered intact.

Water Pollution Control Costs

Data on water pollution control costs were supplied to DPRA by the Effluent Guidelines Division of EPA. DPRA was not in a position to evaluate these costs, and they were assumed to be accurate. A question does arise regarding the applicability of the treatment facility requirements (and costs) as they relate to new sources using the wet processing technology. Waste flows are presumably to be significantly reduced, and waste flow characteristics will probably differ from those sampled by S & P as reported in the Development Document. This further raises a question as to the appropriateness of the BOD and SS guidelines as proposed.